WMO
Performance Assessment Report

2020 - 2022

Long-term Goal 1

Better serve societal needs: delivering authoritative, accessible, user-oriented and fit-for-purpose information and services

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Early Warnings for All Initiative (EW4All)

On World Meteorological Day in 2022, the United Nations Secretary General Antonio Guterres announced that the UN would spearhead a new action to ensure that every person on Earth is protected by Early Warning Systems (EWS) within five years. **The initiative, called Early Warnings for All (EW4All), is co-led by WMO and the United Nations Office for Disaster Risk Reduction (UNDRR).**

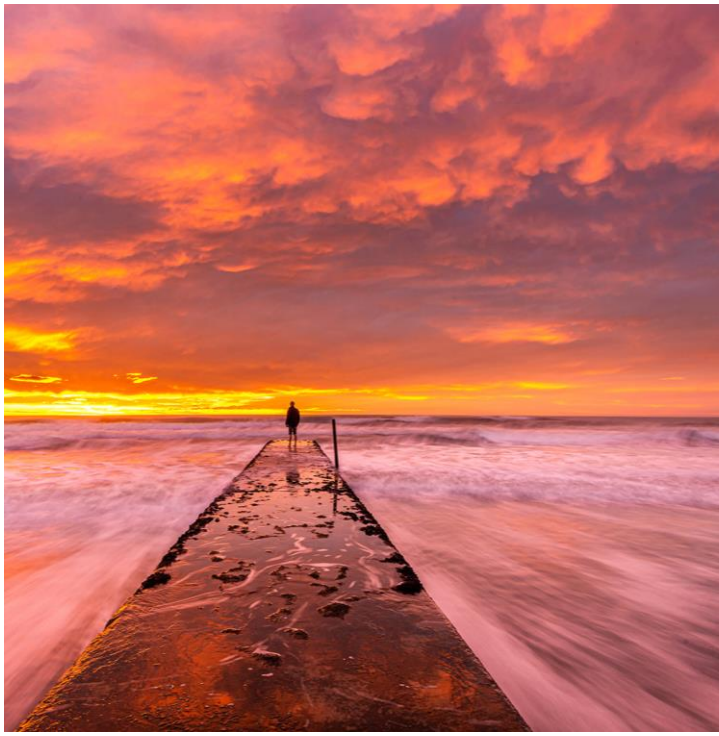
As a first step, the **EW4All Executive Action Plan** was developed and presented at the UN Climate Change Conference in Sharm El-Sheikh, COP-27. Four pillars of work were identified, which correspond to the Multi-hazard Early Warning Systems (MHEWS) value cycle: (1) disaster risk knowledge and management, (2) observations and forecasting, (3) warning dissemination and communication and (4) preparedness and response capabilities. The Executive Action Plan was received with wide support from the COP parties and was reflected in the adopted Sharm el-Sheikh Implementation Plan.

The first meeting of the EW4All Advisory Panel took place on 21 March 2023 alongside the UN Water Conference in New York. The purpose was to galvanize the political and economic support needed to carry on to the next phase of implementation. **This included the announcement of 30 particularly at-risk countries, including Small Island Developing States and Least Developed Countries, in which coordinated support action will start**. Additional countries are expected to be added as this vital work with partners gathers pace, scale and resourcing.

Atlas of Mortality and Economic Losses

In 2021 WMO released its Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970-2019). The Atlas is the most exhaustive compilation to date of fatalities and economic costs from natural hazards. It provides comprehensive details of recorded disasters and their impacts, both at global and regional level. It gives statistics for the entire 50-year period, as well as a decadal breakdown which shows the evolution of disasters in the context of a changing climate.

Monitoring data shows the Atlas as the WMO report with the highest media impact achieved in 2021. **The report is a multi-agency collaboration, with contributions from many partners including UNDRR and WHO.** Statistics are from the Emergency Events Database (EM-DAT) maintained by the Centre for Research on the Epidemiology of Disasters (CRED). More recently, WMO updated the Atlas to cover the timeframe between 1970 and 2021.



Long-term Goal 1

Better serve societal needs: delivering authoritative, accessible, user-oriented and fit-for-purpose information and services

WMO-UNDRR Centre of Excellence for Climate and Disaster Risk Resilience

While climate related hazards, disaster risks and their implications are intertwined, the systems to anticipate, prepare for, prevent, and manage them are not. The current landscape across the spectrum from prevention to preparedness and emergency response is fragmented with a multiplicity of disconnected stakeholders from the weather, climate, development, humanitarian, disaster risk management, social protection, and environment sectors. In addition, while agencies may work bilaterally on specific issues and problems, overall, stakeholders in this space lack a joined seamless flow from science and data to policy and practice.

To respond to these issues, WMO and the UN Office for Disaster Risk Reduction created the Centre of Excellence (CoE) for Climate and Disaster Risk Resilience to work with partner agencies on strengthening efforts to transform scientific knowledge and tools into action supporting climate change mitigation, adaptation, and DRR.

Following the launch, the following partner agencies joined the membership of the CoE:

- Food and Agriculture Organization (FAO)
- Group on Earth Observations (GEO)
- International Federation of Red Cross / Red Crescent Societies (IFRC)
- International Science Council (ISC)
- UN Development Programme (UNDP)
- UN Environment Programme (UNEP)
- UN Institute for Training and Research (UNITAR)
- UN Office for the Coordination of Humanitarian Affairs (UNOCHA)
- UN Education, Scientific, and Cultural Organization (UNESCO)
- World Bank (WB)
- World Food Programme (WFP)

In 2022, a notable output of the CoE was a report titled Moving Back from the Edge. This publication presents case studies to illustrate transformative interventions to avert, minimize, and address loss and damage in high vulnerable and fragile contexts. The report makes a case for greater focus on vulnerability reduction as the common connector between humanitarian, DRR, and climate change actors, and calls for a "vulnerability focus" to break down institutional silos and ensure those who are most at risk in the face of climate change are prioritized.

Regional and Thematic State of Climate Reports

In 2021-2022, for the first time, WMO released a series of region-specific reports to go alongside its global State of the Climate Report. Five such regional reports were published on Africa, Asia, Latin America and the Caribbean, the South-West Pacific and Europe. The reports are based on a standard methodology and incorporate input from NMHSs, WMO Regional Climate Centres (RCCs), research institutions, and international and regional organizations, and leading experts. In addition to a snapshot of key climate indicators like temperatures, sea level rise, ocean heat and acidification, drought, and extreme weather, and the risks and impacts they have on economies and the environment, the reports highlight adaptation measures that should be taken and provide recommendations.

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Also released were the third and fourth editions of the State of Climate Services report. The annual report had a special focus on water in 2021 and highlighted the need for urgent action to improve cooperative water management, embrace integrated water and climate policies and scale up investment. In 2022, it focused on energy and highlighted the huge opportunities to generate clean energy by harnessing renewable resources like wind, solar and streamflow. It also pointed at the importance of investing in climate services for increasing energy resilience to extreme weather events and climate events. A low-carbon energy is key to contrast climate change, improve air quality, conserve water resources, protect the environment, create jobs and safeguard a better future for all.

Climate Science Information for Climate Action

WMO joined forces with the Green Climate Fund (GCF) in an initiative launched at COP26 to provide the international community with new climate information and tools on the latest climate science data. The initiative is expected to contribute significantly to translating science into policy support through informing decisions on investments, particularly for adaptation. WMO is further a key member of UN4NAPs, an UN-wide partnership aimed at scaling up technical support, initially to LDCs and SIDS, to formulate and implement National Adaptation Plans (NAPs). It assists with making NAPs scientifically reliable by downscaling information from the Climate Information platform (CIP) and historical data analysis by Climpact.

Climate indicators and the Sustainable Development Goals

WMO is working towards filling a significant gap between climate science and the knowledge on how climate change risks cascade through environmental, social and economic systems. A first-of-its-kind report addressing this knowledge gap was published as guidance for Members, policy makers and international organizations, on demonstrating the interconnections between the SDGs and WMO's seven climate indicators, namely CO2 concentration, temperature, ocean acidification, sea ice extent, glacier mass balance, ocean heat content and sea level rise. This initiative is coordinated globally in collaboration with the United Nations Statistical Division with inputs and data from National Meteorological and Hydrological Services (NMHSs) and National Statistical Offices (NSOs).

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Water Declaration | Water and Climate Coalition | WMO Vision and Strategy for Hydrology

The Extraordinary World Meteorological Congress (Cg-Ext) endorsed a Water Declaration as a way of accelerating implementation of SDG 6. It further endorsed the Water and Climate Coalition which promotes the sharing and access to integrated hydrological, cryosphere, meteorological and climate information to plan and operate resilient and sustainable water resources systems at local, national, regional and river basin scales. The Coalition brings together 10 UN agencies and the Global Water Partnership. Since its launch in 2020, it has gained 200+ members across NMHSs, academia and the private sector. It is further supported by a panel of 16 eminent political leaders and by UN1FY, a multi-sectoral youth task force.

Cg-Ext also approved the WMO Vision and Strategy for Hydrology and its associated Action Plan which reflects the need to improve water monitoring and management in the face of growing challenges of water stress, water-related hazards and water quality. The Action Plan presents in detail the activities needed to fulfil the eight long-term ambitions of the Strategy: (i) no one is surprised by a flood; (ii) everyone is prepared for drought; (iii) hydro-climate and meteorological data support the food security agenda; (iv) high-quality data supports science; (v) science provides a sound basis for operational hydrology; (vi) we have a thorough knowledge of the water resources of our world; (vii) sustainable development is supported by information covering the full hydrological cycle; and (viii) water quality is known.

Forward perspective

The experience from the COVID-19 pandemic highlighted the need to embrace **a truly multi-hazard, cross-border approach in an interconnected world** to make progress towards the global goals on climate action, disaster risk reduction and sustainable development. In the next two years WMO will build on the frameworks, partnerships and action plans highlighted above to accelerate action on early warnings, climate science information, climate adaptation, water resources management, and the provision of tailored decision-support products and services.

Long-term Goal 1 | 2022 Key Performance Indicators (Summary)

Strategic Objective 1.1

KPI 1.1.1a	KPI 1.1.1b	KPI 1.1.2a
Alerts made openly available through regional platforms	Alerts made openly available through WWIS	Warnings provided to SWIC 2.0 in CAP format
72 = 0%	**109** ▼8%	**116** ▲75.8%

KPI 1.1.3a	KPI 1.1.3b	KPI 1.1.4
National platform coordinating DRR activities	NMHS membership in the national DRR platform	High-impact events catalogued with WMO identifiers (pilot)
100 *snapshot**	**97** *snapshot**	**19** = 0%

Strategic Objective 1.2

KPI 1.2.1a	KPI 1.2.1b	KPI 1.2.2
Full and advanced climate services provision capacity	Basic and essential climate services provision capacity	NMHSs contributing to climate-relevant outputs
58 ▲142%*	**102** ▲55%*	**135** ▲87.5%*

KPI 1.2.3a	KPI 1.2.3b
Impact of WMO climate-related flagship products	Impact of WMO climate-related flagship products
17.5M impressions	**290K** media mentions

**As this data originates from yearly surveys, it is heavily affected by response rate volatility.*

Long-term Goal 1 | 2022 Key Performance Indicators (Summary)

Strategic Objective 1.3

KPI 1.3.1	KPI 1.3.2a	KPI 1.3.2b	KPI 1.3.3
Established HydroSOS mechanism (pilot)	Riverine floods forecasting and warning services	Flash floods forecasting and warning services	Operational drought warning systems
79 ▲58%	**79** *snapshot**	**58** *snapshot**	**53** *snapshot**

Strategic Objective 1.4

KPI 1.4.1a	KPI 1.4.1b	KPI 1.4.1c	KPI 1.4.2
QMS for aeronautical meteorological services	QMS for marine services (all stages)	QMS for Early Warning Services (EWS)	SEB analysis conducted in the past 10 years
130 *snapshot**	**34** ▲9.7%*	**72** ▲18%*	**34** ▼2.9%*

KPI 1.4.3a	KPI 1.4.3b	KPI 1.4.3c	KPI 1.4.3d
Established PPE engagement on service delivery	Established PPE engagement on networks operation	Established PPE engagement on observation data	Consultative platform for PPE dialogue
57 ▲18.8%*	**42** ▲10.5%*	**46** ▲9.5%*	**48** ▲26.3%*

KPI 1.4.4a	KPI 1.4.4b
Service delivery with web applications	Service delivery with social media
71 *snapshot**	**67** *snapshot**

**As this data originates from yearly surveys, it is heavily affected by response rate volatility.*

Strategic Objective 1.1

Strengthen national **multi-hazard early warning/alert systems** and extend reach to better **enable effective response** to the associated risks

Outcome/Focus Area A:

Enhance impact- and risk-based extended forecast and warning products and services to enable better preparedness and response to hydrological and meteorological events

#Guidelines on MHEWS #integration of Severe Weather Forecasting Programme (SWFP), Tropical Cyclone Programme (TCP), Coastal Inundation Forecasting Initiative (CIFI), Flash Flood Guidance System (FFGS) and riverine flooding into MHEWS Interoperable Environment #Operationalization of approach to cataloguing hazardous weather, climate, water and space weather events

Outcome/Focus Area B:

Strengthen national capacity in multi-hazard early warnings

#CAP standard installed and operational #Development and implementation of operational MHEWS

Outcome/Focus Area C:

Enhance access to official national meteorological and hydrological forecasts and warnings globally in support of regional and global requirements

#GMAS #Regional and global platforms on disaster risk reduction #Operational warnings integrated in GMAS (e.g. marine, tropical cyclone, drought, flood, air borne hazards, etc.) #Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes #Early warning and advisory services to UN and humanitarian agencies

Overview

Strategic Objective 1.1

Strengthen national multi-hazard early warning/alert systems and extend reach to better enable effective response to the associated risks

SDG Contribution

ON TRACK

- Joint UNDRR-WMO Global Status of Multi-Hazard Early Warning Systems: Target G Report released in 2022
- **Broad support for the Early Warning for All Initiative**, including:
  - Maputo Ministerial Declaration on Bridging the Gap between Early Warning and Early Action (5-9 September 2022, Maputo, Mozambique)
  - Statement from the joint SERCOM/INFCOM Technical Conference on EW4All: UN Global Early Warning Initiative for the Implementation of Climate Adaptation (Geneva, Switzerland, 22 October 2022)
  - G20 Bali Leaders' Declaration (Bali, Indonesia, 15-16 November 2022)
- WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019) (WMO-No. 1267) published
- WMO Guidelines on Multi-hazard Impact-based Forecast and Warning Services (WMO-No. 1150) published
- Advances in the provision of advisory services to UN and humanitarian agencies
- **WMO-UNDRR Centre of Excellence for Climate and Disaster Resilience concept developed and work plan drafted**
- WMO contribution to 9 UN inter-agency reports and regular participation in UN-wide platforms and initiatives
- **Support to Members provided with the development of operational MHEWS** (Burkina Faso, Chad, Democratic Republic of Congo, Togo, Comoros, Mauritius, Seychelles, Tanzania, Kenya, Uganda, Central Asia, Afghanistan, Haiti, Fiji, South-Eastern Europe).
- Common Alerting Protocol (CAP) e-learning platform launched and training provided to Members
- Training material on impact-based forecasting developed
- Capacity development of Members on severe weather and impact-based forecast and warning services was conducted in the form of online/hybrid workshops benefitting Members in South Asia, Southeast Asia, Eastern Africa, West and Central Africa, South Pacific and Eastern Caribbean, as a record-breaking level of activity in a single year in 2021.
- **First global knowledge platform dedicated to climate and health (ClimaHealth.info) launched by the WMO/WHO Joint Office**
- Climate Service Provider Profiles on health updated: 99 National Health Focal Points from 66 countries have been identified from NMHSs and RCCs

On track

Continued efforts required

Limited progress

COVID-19 Impact

Challenges & Risks

Overview

Strategic Objective 1.1

Strengthen national multi-hazard early warning/alert systems and extend reach to better enable effective response to the associated risks

SDG Contribution

CONTINUED EFFORTS REQUIRED

- **Global Multi-Hazard Alert System (GMAS)**
- Provision of impact-based forecasts and warnings
- **Provision of warnings to SWIC 2.0 using the CAP format**
- Application of WMO operational approach to cataloguing hazardous weather, climate, water and space weather events
- Identification of additional requirements for multi-hazard emergency response
- Development of heat-health warning system guidelines (draft)
- Online Monthly Bulletins on the Global Heat Health Information Network (GHHIN)

COVID-19 IMPACT

- **Delays experienced in the implementation of project activities at the national level,** particularly in organization of workshops, trainings, equipment installation, and data gathering missions.
- All meetings of Standing Committee on Disaster Risk Reduction and Public Services (SC-DRR) and its expert teams and advisory groups held but delays in delivery were experienced.
- **Indirect impact in longer implementation timeframes when working online**, with a spill-over effect on staff workload and priorities.
- A survey on the impacts of the pandemic on NMHSs operation in 2020 clearly showed that, while no major disruption was reported, a number of Members were challenged by the rapid development of the situation. They had challenges to sustain their operations of all sorts, from maintenance of observation networks to the delivery of services. A number of Members reported, that only critical services could be delivered in the climax of the crisis. This led to a situation which needed prioritization according to available resources.
- WMO Research Board COVID Task Team in conjunction SG-HEA developed a framework on COVID-19.

CHALLENGES & RISKS

- **Turnover among and level of engagement of the experts** working on the expert teams for some major Standing Committees.
- Some **Standing Committee members less active** and therefore delay in delivering of normative work.

On track

Continued efforts required

Limited progress

COVID-19 Impact

Challenges & Risks

Focus Area A

As of December 2021, **65 Members provide impact-based forecasting.** This represents 34% of WMO's 193 Members, indicating a considerable gap in provision globally. Severe weather forecasting capabilities are improving, but are still limited in Regions I and V where the majority of SIDS and LDCs are concentrated.

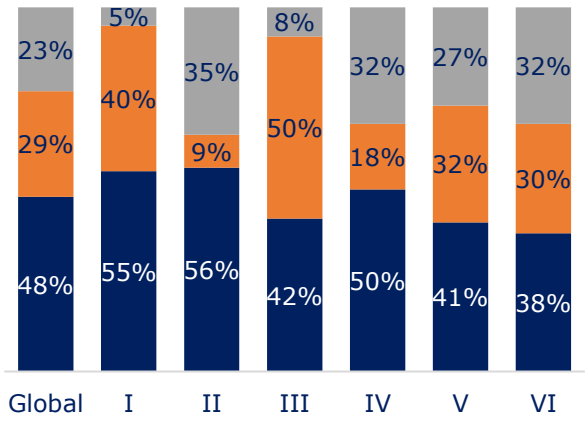


Figure 1.1 Proportion of Members providing impact-based forecasts and warnings, WMO Monitoring, 2022

In 2021 WMO expanded its Guidelines on Multi-hazard Impact-based Forecast and Warning Services (WMO-No. 1150) with practical information and case studies on how to move from weather forecasts and warnings issued by NMHS to the provision of impact-based forecast and warning services of multiple cascading hazards (for instance a tropical cyclone, which triggers flooding, storm surge, wind damage, impacts on infrastructure, transport and energy and on health systems). The new edition benefits from significant research into exposure and vulnerability and incorporates extensive input from both service providers and the user community. Complementing this, WMO has also, in 2022, published new **Guidelines on Implementation of a Coastal Inundation Forecasting-Early Warning System (WMO-No. 1293)**, as requested by Congress-18. These Guidelines are a valuable planning tool for establishing a multi-hazard early warning system that builds resilience to inundation (from multiple sources – marine and hydrological) through reduced exposure and vulnerability of coastal communities. WMO-No 1293 is one of WMO's contributions to EW4ALL and has also been endorsed as an activity of the UN Ocean Decade of Ocean Science for Sustainable Development.

The **WMO cataloguing of hazardous weather, climate, water and space weather events** was tested in Region VI through the Regional Climate Centre Node on Climate Monitoring in Offenbach, Germany, in West Africa (Region I) through the AGRHYMET Regional Center, and in Region V through the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG). In the reporting period 19 Members applied the operational approach in this pilot phase: Australia, Cyprus, Denmark, France, Germany, Indonesia, Latvia, Luxembourg, Moldova, Netherlands, Norway, Philippines, Romania, Spain, Sweden, Switzerland, Turkey, Ukraine, and the United Kingdom.

Forward perspective

Cg-19 is expected to approve an Implementation Plan for Cataloguing Hazardous Events. Whereas its implementation will start in the second half of 2023, it will mostly take place in the next financial period when a mechanism and an interface for Members to provide contributions will be developed.

A template for strategies connecting alerts to decision making is expected to be created by 2023 but not scaled up. A baseline on the accuracy and quality of forecasts and warnings will also be needed.

A workplan in support of EW4All is being developed . Countries which are listed in the first batch of EW4All beneficiaries will be engaged in the regional operational mechanisms of WMO programmes and initiatives to improve access to information and guidance products from the global and regional centres as well as to enhance capacity on the use of information for impact-based forecasting and early warning services.

Focus Area B

Considerable effort went into supporting Members with the development and implementation of **operational Multi-Hazard Early Warning Systems** (MHEWS), including:

- Regional Meteorological Early Warning System in the Lake Victoria Basin
- Central Asian Flood Early Warning System
- South-East European Multi-Hazard Early Warning Advisory System
- Hydrometeorological warning system in Haiti
- Assessments for Cook Islands, Fiji, Kiribati, Nauru, Niue, Tokelau, and Tuvalu
- MHEWS diagnostics completed for Chad and Togo; and ongoing in Comoros, Madagascar, Mauritius, Seychelles
- Implementation and operationalization of Fiji FFGS and Southeast Asia FFGS

A core set of 22 custom indicators for measuring the effectiveness of MHEWS was developed, including methodologies for computation, under the CREWS Initiative. The indicators will supplement the Target G global indicators within the Sendai Framework Monitor. Members can choose to use all indicators or select the ones most appropriate to their context. Characteristics of an effective MHEWS were also identified in the process.

The vast majority of Members have a corpus of legislative texts (laws, decrees etc.) and regulations establishing DRR policy and implementation framework. Less than 40% of Members (39%) have reported legislation on MHEWS.

As evident from Figure 1.2, **the number of Members providing warnings in CAP format to the Severe Weather Information Centre (SWIC) 2.0 almost doubled from 66 to 116 globally.** The positive trend was observed in most regions, though it remained largely unchanged in Regions III, V and VI . The biggest increase was registered in Region I, where a targeted fast-tracking CAP implementation initiative took place. It involved WMO entering into an Implementation Arrangement with NMHSs that have already implemented CAP to assist others in the region.

The main challenge lies in NMHSs implementing a functional CAP system but failing to include the use of CAP in Standard Operating Procedures. To this end, **WMO developed a set of e-learning resources and courses on CAP** in 2020-2022 and made them available on the Moodle platform. The resources are designed to enhance Members' understanding of CAP, including what it is, what it does, how it works, how to issue alerts, and how to manage and set up CAP.

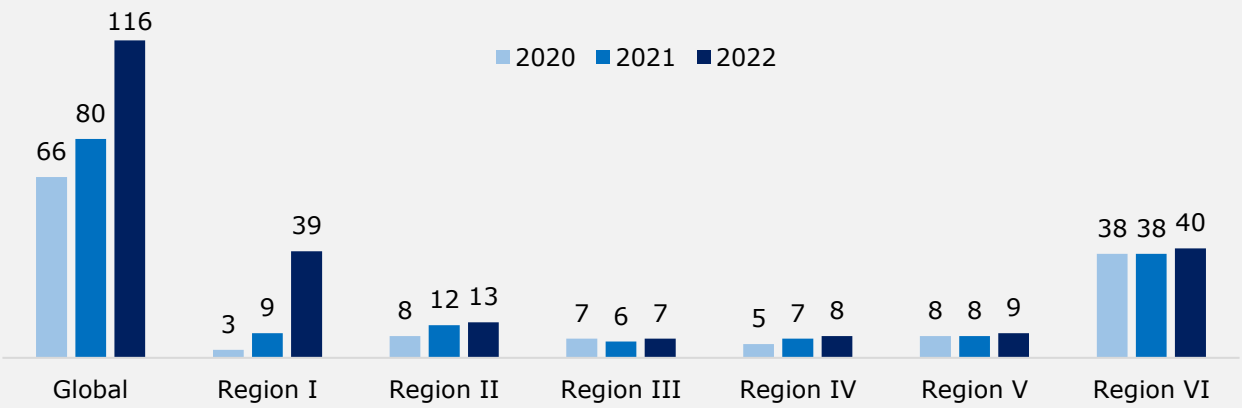


Figure 1.2 Number of Members providing warnings in CAP format to SWIC 2.0, Source: WMO Alert Hub & SWIC 2.0, 2022

Forward perspective

The Expert Team on GMAS developed a draft 3-year GMAS Transformation Map for 2021-2023 in terms of CAP, impact-based forecasting and policy. Even if fully implemented, it is estimated that 40% of Members will still not be issuing warnings in CAP format or issuing impact-based forecasts by end-2023. Looking into 2024 and beyond, CAP will have to be integrated in the WMO technical regulations. DRR-related standards will also have to be developed.

Focus Area C

No new **regional warning platforms** were developed in 2020-2022 in addition to the ones existing in Region II (GMAS-Asia, Meteoalert) and Region VI (Meteoalarm).

The Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970-2019) was published in 2021, attracting a huge interest from the media, policy makers and the wider public. See more details in the LTG 1 summary section.

In addition to the WMO-UNDRR Centre of Excellence for Climate and Disaster Resilience featured earlier, work advanced on the development of WMO Coordination Mechanism (WCM), including the approval of its Implementation Plan by EC-76. WCM will enable access to authoritative weather, water, climate information and expert advice from WMO Members to the UN and humanitarian agencies for anticipatory action and crisis support.

Forward perspective

GMAS is expected to be piloted in four more regions (I, III, IV and V) by 2023. Its full operationalization will take place from 2024 onwards when more hazards (e.g. sand and dust, fires, coastal inundation) should further be incorporated into MHEWS.

Cg-19 is also expected to **approve the WCM Implementation Plan as an established mechanism for providing advisory services to UN and humanitarian agencies**. Its implementation will then come to the fore from 2024 onwards. While the main objective is to support international humanitarian organizations, another important element will be in the provision of assistance to Members, i.e. their national humanitarian mechanisms and capacity development for NMHS.

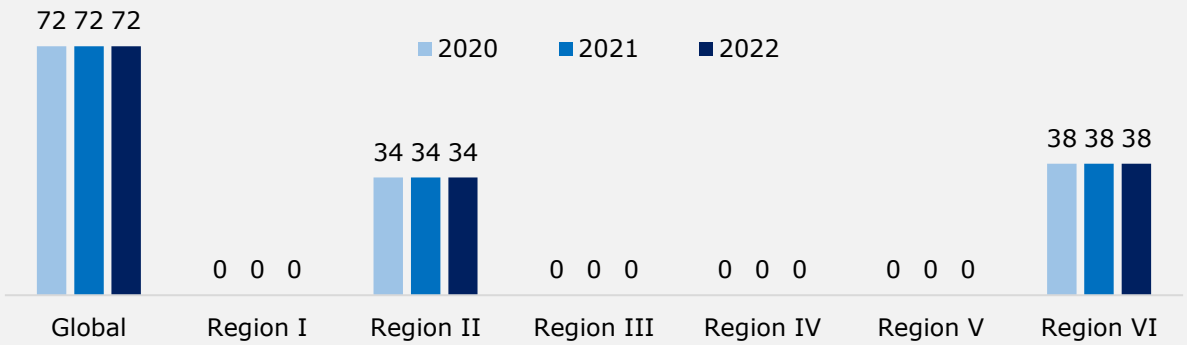


Figure 1.3 Number of Members participating in regional warning platforms in 2020-2022, Source: MeteoAlarm; MeteoAlert; GMAS-Asia, 2022

Project Highlights:

CREWS Chad

RA I | CHF 1.4 Mio |2019-2024

In Chad, **the methodology for Country Hydromet Diagnostics has been applied and a report/diagnostic has been developed through the Alliance for HydroMet Development**. The diagnostic is based on the ten most critical elements of the hydrological, climate and meteorological value cycle, grouped under different categories: observation and processing systems, services and production and dissemination, users and stakeholder interaction. The results of the diagnostic will be applied in planning future, prioritized activities in the country. Further, the West Africa Severe Weather Forecasting System is now online, the Regional Specialized Meteorological Centre Dakar Training Desk is operational, and training and guidance material in French and English is available to strengthen capacity.

Under CREWS Projects, Togo, Seychelles, Chad, Lao PDR and Cambodia have made multi-hazard early warning capacities diagnostics.

CREWS West Africa

RA I | CHF 4 Mio | 2018-2023

Under the project, a catalogue of extreme events was developed in partnership with the German Weather Service The West Africa hydrological, meteorological and climate extreme database (WACE), involving a standard typology of high-impact event types and the assignment of a Universal Unique Identifier (UUID), with supporting training and guidance materials both in French and English is accessible since May 2021 and has been transferred to the Regional Center AGRHYMET.

Further, the West Africa Severe Weather Forecasting System is now online, the Regional Specialized Meteorological Centre Dakar Training Desk is operational, and supporting training and guidance material in French and English is available in order to strengthen capacity.

European Union | Focus Africa

RA I | CHF 1.1 Mio (WMO component)| 2020-2024

Under the Focus Africa project, a full report on the regional extreme events for the Southern African Development Community (SADC) countries was made in order to increase the understanding of the impact of climate variability on the quality of seasonal and decadal forecasts in terms of extreme events characterization. The teleconnection between El Niño Southern Oscillation (ENSO) and rainfall over Africa was analyzed, as well as potential changes in the future. In addition, a showcase for Lake Malawi, a generalized understanding of the characteristics and synoptic drivers of two types of extremes - localized rainfall and area- averaged rainfall - was provided. Finally, a climate risk analysis generated by severe weather events through a specific multi- hazard Extreme Climate Index (ECI) was executed, which is and will particularly efficient in detecting extreme events in the SADC region.

World Bank and European Commission |South-East European Multi-Hazard Early Warning Advisory System Phase II

RA VI | CHF 868.000 |2018 –2022

The pilot phase of the SEE-MHEWS Phase II Project was finalized with all project activities implemented as planned. In 2022, the development of pilot hydrological modeling system for Vrbas River catchment in Bosnia and Herzegovina and Vardar River catchment in North Macedonia, pilot nowcasting system for Bosnia and Herzegovina, development of the Common Information Platform for dissemination and visualization of various system outputs, and setting up of online Numerical Weather Products (NWP) verification were finalized. Countries benefiting from this initiative are Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Greece, Hungary, Israel, Jordan, Lebanon, Montenegro, Republic of Moldova, Romania, Serbia, Slovenia, North Macedonia, Turkey, Ukraine.

Strategic Objective 1.2

Broaden the **provision** of policy- and decision-supporting **climate information** and **services**

Outcome/Focus Area A:

Advance a climate service information system enabling all Members to access, and add value to, the best available global and regional climate information products and methodologies through improved processing, exchange and enhancement of information on past, present and future climate.

#Climate Data Management System (CDMS) #Climate Services Toolkit (CST) #Objective regional sub-seasonal and seasonal forecasting systems #Regional coordination of downscaling of annual to decadal prediction and climate change projection products #Global-regional-national-regional-global exchange of GFCS-relevant data and products

Outcome/Focus Area B:

Support Members' production and delivery of authoritative national climate information products and services in GFCS priority areas to adapt and respond to climate variability and change, including through participation in National Adaptation Plans, and to avert loss or damage as well as to optimize benefits from climate-related opportunities.

#National Adaptation Plans (NAPs) #National Frameworks for Climate Services (NFCS) #Tailored decision-support products on multiple timescales #Basic Instructional Package for Climate Services (BIP-CS) #Quality Management Standards for climate services #Peer-to-Peer twinning #Cataloguing of climate services-related training

Outcome/Focus Area C:

Refine WMO products containing key climate indicators, seasonal outlooks, and improved characterization of extremes and associated impact information recognized as key inputs for international climate-related policy implementation and UN system action.

#WMO Climate Indicators #State of Climate Reports #ENSO bulletins #Global Seasonal Climate Updates #Information System Portal #Seasonal climate updates to UN and humanitarian community #Regional Climate Forums #Regional Climate Centres (RCCs)

Strategic Objective 1.2

Broaden the provision of policy- and decision-supporting climate information and services

SDG Contribution

ON TRACK

- Considerable impact on policy decision making achieved through a growing range of WMO climate-related reports. The State of the Global Climate Report, WMO's most referenced and covered product, and the newly launched 5 Regional Climate Reports were formally noted in the Sharm el-Sheikh Climate Pact concluded at COP27.
- The State of Climate Services Report gained increased outreach. It further demonstrated its value in supporting Members with the development of NAPs and NMHS Strategic Plans as well as in the design and implementation of projects. Three reports were published featuring GFCS-related areas: disaster risk reduction in 2020, water in 2021 and energy in 2022.
- Climate science information for climate action: launched at COP26, this partnership between WMO and the Green Climate Fund (GCF) is expected to have a big contribution to translating science into policy support through informing decisions on investments, particularly for adaptation. The initiative will bring the National Frameworks for Climate Services (NFCS) closer to adaptation planning and practices at the country level.
- Quality Management System (QMS) implementation was initiated for climate services for the first time. Five internal auditing training courses in all regions started to enable NMHSs to monitor their climate services performance.
- Regional Climate Outlook Forums (RCOFs) are regularly conducted across a wide range of regions and sub-regions, with region-specific guidance issued for the production of objective seasonal forecasts in 10 sub-regions.
- Regular WMO contribution to humanitarian activities, including a rollout of WMO updates on El Niño Southern Oscillation (ENSO) evolution and its regional and local impacts, and development of prototype seasonal climate information portal facilitating the delivery of highlights, products, guidance and useful weblinks.
- Implementation Plan for Advancing Integrated Climate and Health Science and Services 2023–2033 developed and submitted to Cg-19 for adoption.
- Best practices for integrated weather and climate services in support of net zero energy transition are guidelines for the NMHSs in supporting national strategies for decarbonizing the national energy systems and mitigation plans.
- Recognition of WMO's contributions in resolutions of the United Nations Convention to Combat Desertification (UNCCD) at UNCCD COP-15 related to GFCS and drought issues.
- Several guidance materials developed for global agrometeorological communities on roving seminars, NWP applications for agriculture and impacts of air pollution on crop production.

On track

Continued efforts required

Limited progress

COVID-19 Impact

Challenges & Risks

Strategic Objective 1.2

Broaden the provision of policy- and decision-supporting climate information and services

SDG Contribution

CONTINUED EFFORTS REQUIRED

- Development and application of step-by-step guidelines for establishing NFCS with high-level guidance regarding the integration of weather and hydrological services within the NFCS, as some countries may wish to develop a national framework that encompasses weather, water and climate services.
- Development of guidance on use and interpretation of climate change projections.
- Methodology on science-based design of weather and climate resilient renewable energy systems, capacity development material and energy meteorology platform for tailored energy services.
- Establishment of a network of national CSIS Focal Points (NCFPs), and introductory forums for NCFPs in each WMO region.
- Data rescue project implementation in Haiti, DR Congo and Chad.
- Strengthened development of marine climate services, especially for the requested areas of attention including marine climatology, marine heatwaves, ENSO, polar climate services, and fisheries/aquaculture services.
- Stakeholder workshops on tailored climate
- Digital Agricultural Advisories developed with FAO
- Recommendations on Climate Services for Fisheries and on Indigenous and Local Knowledge on Weather and Climate Services (FAO, UNESCO, WMO) developed.
- Database on agricultural flux measurements created.

On track

Continued efforts required

Limited progress

COVID-19 Impact

Challenges & Risks

Overview

Strategic Objective 1.2

Broaden the provision of policy- and decision-supporting climate information and services

SDG Contribution

COVID-19 IMPACT

- Some delays experienced, more pronounced among projects (e.g. ClimSA, ENANDES, FOCUS-Africa, CREWS West Africa).
- **Travel restrictions delayed face-to-face trainings**; virtual workshops were conducted, to the extent possible, but proved difficult to communicate technical knowledge online.
- **Work on NCOFs was affected**, with only limited opportunities for in-country promotion and inability to conduct writeshops.
- Work on the Basic Instructional Package for Climate Services (BIP-CS) continued remotely but the **large time zone differences posed challenges to communication** with and among its authors.
- The implementation of customized Climate Services Toolkit was delayed.
- Peer-to-Peer twinning between NMHSs for climate services provision was deferred to 2022 due to inability to conduct scoping missions.

CHALLENGES & RISKS

- Lack of technical regulations on climate services.
- As of December 2022, **167 Members have submitted the Climate Services Checklist** and missing data from the remaining Members is being tackled with the assistance of the Regional Offices, including a data verification process.
- Need to expand the forecast time range for RCOFs from seasonal to inter-annual/annual. Work to this end was initiated in some regions.
- QMS for climate services offers an opportunity to introduce an ISO auditing process and certify Members' functional capacity across the value chain. However, it may prove costly for some Members. A light verification process is also being piloted.
- **A strategy for timing the launch of WMO reports is required to** avoid saturation. The sustainability of the Regional State of the Climate Reports also needs to be ensured.

On track

Continued efforts required

Limited progress

COVID-19 Impact

Challenges & Risks

Focus Area A

Figure 1.5 presents **Members' level of capacity for the provision of climate services based on data provided by 167 Members to date in response to the Climate Services Checklist**. Region I is the region with highest number of Members in the "less than basic" category, with gaps in the basic systems, user interface and M&E components of the value chain. The 7 Members that have less than basic capacity to deliver climate services are located in Regions I, IV and VI.

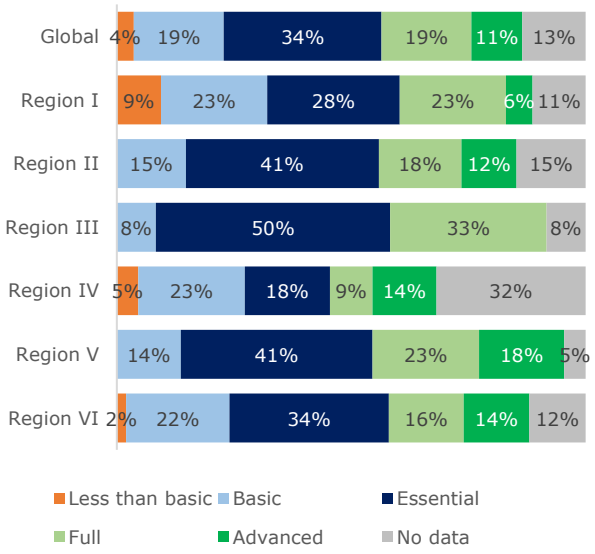


Figure 1.5 Number of Members with basic, essential, full and advanced climate services provision capacity, Climate Services Checklist September 2022

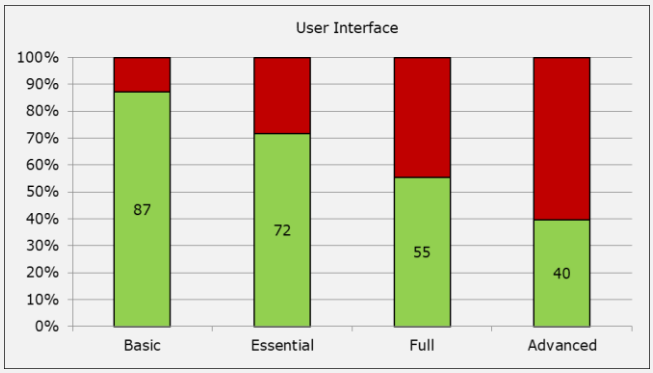
The checklist data has been examined along 6 components of the climate services value chain including governance, basic systems, user interface, capacity development, provision and application of climate services, and monitoring and evaluation. Twelve NMHSs are audited by ISO-certified external auditors who have identified the gaps and remedial actions.

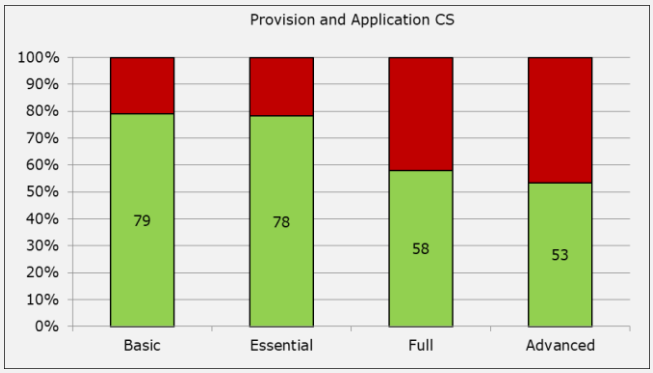
As compared to the baseline, the capacities in the basic systems component have improved, while a significant gap remains on the M&E component across all regions (Figure 1.6).

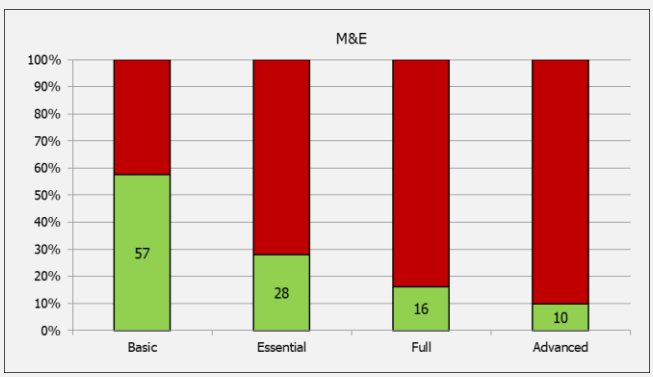
More effort is required in strengthening: (1) institutional capacities to complete the climate services value chain for adaptation planning and decision making, and to document associated socio-economic benefits; (2) research to improve underlying predictions and projections and to transition research results into operation; (3) systems operationalization to promote the exchange of GFCS-relevant data and products among countries and between national, regional and global centres; (4) monitoring and evaluation of the results and benefits of the use of climate services (the weakest area).[1]

Figure 1.6.1 Climate Services capacities overview, Climate Services Checklist April 2023

[1)] 2019 State of Climate Services Report, WMO-No. 1242







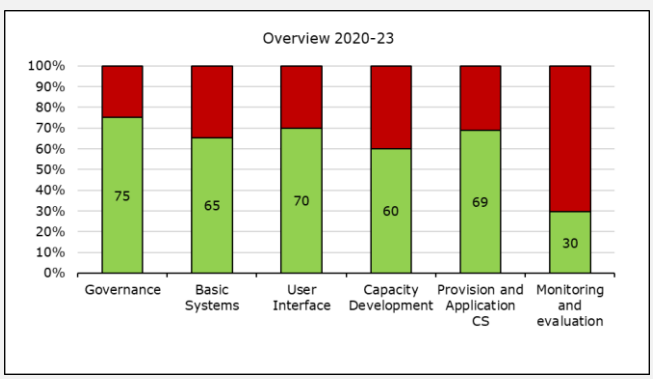


Figure 1.6.2 Climate Services capacities overview, Climate Services Checklist April 2023

Forward perspective

Expected developments:

- Verification of checklist data and auditing of selected number of Members every year
- Seasonal Climate Information Dashboard development
- Systematic integration of climate services capacity baseline assessments into project proposals (I.e. Intra-ACP Climsa, FOCUS Africa, BRAVA, ENANDES).

New WMO flagship data: Climate Normals 1991-2020

- Coordination of the global data collection and assistance with building national capacity to calculate the climate normals.
- Three series of regional consultations held in 2021 and 2022 with more than 100 Members and more than 700 participants.
- 136 Members and 3 non-Members submitted 1991-2020 CLINO as of mid-March 2023.
- The data would serve as a foundation for national legislative norms and as a reference value for the characterization of weather and climate anomalies.

Climate Data Management System (CDMS)

- A new OpenCDMS website established. The first beta version of the OpenCDMS software is planned to be released prior to Cg-19.

Objective regional sub-seasonal and seasonal forecasting systems

- A rolling process for objective seasonal forecasting launched and successfully progressing in several RCOFs.
- Region-specific guidance developed for the production of objective seasonal forecasts in 10 sub-regions :
  - 7 in Africa, Caribbean and Pacific (ACP RCOF regions)
  - 1 MedCOF (includes SEECOF and PRESANORD regions)
  - Ongoing development of regional guidance for South America WCSACOF sub-region
- Training developed and delivered in MedCOF sub-region
- A Guidance on CSIS Core Functions and Operations at the Regional Scale with focus on ACP sub-regions developed.

African S2S and Climate Services Toolkit development

- Pan-Africa online user guide and interactive tool for S2S developed between Meteo-France and the West African weather forecasting services: ANACIM (Senegal), Mali Meteo, ANAM Burkina Faso, DMN Niger, ANAM Chad and DMN Togo.

Focus Area B

135 Members are contributing scientific information and knowledge to national climate related policies and plans, such as National Adaptation Plans (NAPs), Nationally Determined Contributions to the Paris Agreement (NDCSs), and their National Communications to UNFCCC.

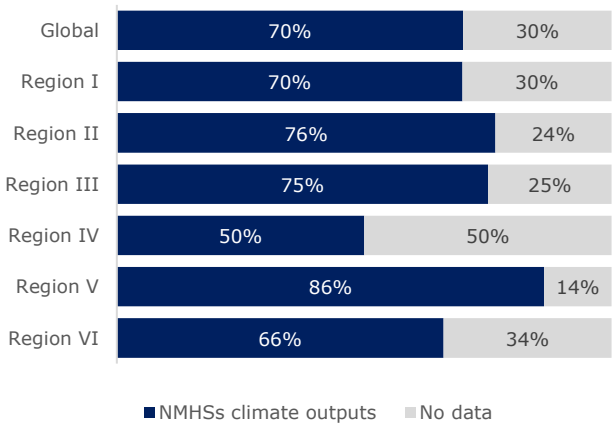


Figure 1.7 Members with NMHS contributing to climate-relevant outputs through national multi-stakeholder mechanisms, Climate Services Checklist 2022

Climate Science Information for Climate Action

As highlighted earlier, WMO and GCF launched this initiative to provide the international community with new climate information and tools on the latest climate science data. The resource pack includes detailed technical guidance, case studies and two-online platforms:

- A Climate Information Platform (climateinformation.org) that provides access to projections of over a dozen climate change indices for the globe, for example, coupled atmospheric and ocean monitoring and regional and downscaled climate modelling.
- Online access to Climpact for calculation of over 70 indices associated with climate impacts, from historical daily temperature and precipitation data (Climpact (climpact-sci.org)).
- An accompanying guidance document explains how these tools can be used to recognize climatic and non-climatic factors contributing to socio-economic and environmental impacts, to guide the identification of effective climate actions.

These knowledge products are particularly useful for adaptation planning and in the development of proposals for climate finance. They were developed by WMO experts working with national and international partners in Cabo Verde, Cambodia, Democratic Republic of Congo, Eswatini, Malawi, St. Lucia, South Africa and Zambia. Further workshops are in the pipeline. This initiative was officially launched in a joint event with the Green Climate Fund (GCF) at COP 26, in Glasgow, UK.

Forward perspective

With the increasing urgency of accelerating climate action under the Paris Agreement in response to climate change, NMHSs may expect to be increasingly called upon to provide climate science information as inputs to NAPS, NDCSs and investments (see below). This input will provide opportunities for identifying and obtaining support for strengthening hydro meteorological systems and services.

NAPs and National Frameworks for Climate Services

- New edition of Supplement to the Technical Guidelines for The National Adaptation Plan Process (WMO No. 1170) and two annexes submitted to UNFCCC at COP 26.
- The updated version of the publication titled "Developing the Climate Science Information for Climate Action"(WMO-No. 1287) was released in English and Spanish.
- NAP/NFCS support rollout in 8 countries in cooperation with UNDP-UN Environment National Adaptation Plan Global Support Programme (NAP-GSP) Alliance and the UNFCCC established UN4NAPs mechanism: Burundi, Central African Republic, Chad, Democratic Republic of Congo, Papua New Guinea, Sierra Leone, South Sudan, Timor-Leste.
- Support provided to develop NFCS, National Strategic Plan (NSP) and National Action Plan in Armenia and Namibia.
- Burkina Faso: a report on the evaluation of socio-economic benefits prepared
- National Climate Outlook Forums in several Member states, including in Comoros, Fiji, Paraguay, Rwanda, Samoa and Zimbabwe, held from 2021 to February 20234 assessment reports on needs and capacities for climate services at the sub-regional level (Francophone Africa; Anglophone Africa, Caribbean and Pacific).

Climate Services to the Agricultural Sector:

- Agricultural Meteorological Practices (WMO-No. 134) and Basic Guidelines for the Organization of Roving Seminars for Farmers on Weather and Climate published.
- Ethiopia, Uganda and Kenya (ACREI Project): 60 farmer field schools across 30 communities in 5 locations receiving tailored downscaled seasonal and intraseasonal forecasts to support agricultural adaptation and resilience.
- Reports from SC-AGR ETs finalized: , guidance on agroclimatic data series; guidance on estimation of crop and livestock losses per extreme weather events, guidance on applications of weather forecasts, impacts of tropospheric ozone and particulate matter on crop yields.

Climate Services Toolkit

- A roadmap for Climate Services Toolkit (CST) customization and deployment at national level approved.
- Stocktaking Capacities, Gaps and Needs for Developing Effective Climate Services in Bhutan developed following consultations with 14 stakeholders.
- Bhutan CST web portal developed and operationalized and NMHS and sector staff trained

Quality Management System (QMS) for Climate Services

- QMS implemented for climate services for the first time.
- Five internal auditors' courses of QMS for climate services held and twinning workshops between ISO-certified NMHS and LDCs conducted (Azerbaijan with Australia and Turkey; Armenia with Australia, Germany, and South Africa).
- Training of internal auditors for Members from Regions I, II, III, IV, V and VI conducted with participants from 53 NMHSs.

Capacity Development

- Competency Assessment for Climate Services (WMO-No. 1285) published.
- Guidance on Communicating Climate Science and Services (WMO-No. 1288) published.
- The fourth edition of the Guide to Climatological Practices (WMO-No. 100) was confirmed by SERCOM 2 and approved by EC-76.
- The Basic Instructional Package for Climate Services (BIP-CS) drafted and is being reviewed by SERCOM.
- Development of draft curricula, modules and strategy on capacity development on weather and climate services for energy.

Highlights of trainings conducted (non-exhaustive list):

- WMO/FAO/EUMETSAT/MeteoRomania Virtual Training Course on the Use of Satellite Products on Drought Monitoring and Applications in Agrometeorology (November-December 2020)
- Summer school on mastering the development of climate services for energy conducted, September 2021
- Weather and Climate Services for the energy sector in Central Asia: training course for practitioners and policy makers, February 2022As part of Adaptation Programme in Africa (GFCS APA) phase II: Building Resilience in Disaster Risk Management, Food Security and Health
  - Malawi and Tanzania: Three trainings. Capacity development on data series management, climate and agroclimate indexes and crop calendars in February 2021. Training on CDT tool in connection with ENACTS to improve data, products and agromet bulletins in March 202 Training on the use of satellite data and products for agriculture and drought monitoring for Eastern Africa with ICPAC. September 2021
- Virtual Training on the Use of Climate Data Tool (CDT) for Generation of Agrometeorological Information in Malawi and Tanzania (March 2021)
- Training on Climate and agroclimate indices plus weather derived Crop calendars for the Met. Services of Tanzania and Malawi (February 2021)
- Bhutan: training workshop for deployment of Climate Services Toolkit.
- Indian Ocean Training Workshop on Basic Climate Statistics.
- Two demystifying workshops on Quality Management System in Climate Services (Azerbaijan and Armenia)- January and February 2021.
- Internal Auditing in QMS for climate services for 53 NMHSs in all regions
- Climate Risk Management Seminar- July 2021
- ClimAdapt Workshop- (India, Iran, Nigeria, South Africa)- November 2021
- Mali, Chad and Togo: capacity development of experts on crop calendars and standard climate and agroclimate indices – July and October 2021 CREWS projects
- Mesas Tecnicas Agroclimaticas. Workshop offered by IDEAM (Colombia) on the development of those structures for capacity building and user interface on weather/climate services for agriculture. March 2022. Project ENANDES
- Capacity development of agromet experts on the use of data series, creation of agromet indices and crop calendars. May 2022. Chile, Colombia and Peru. Project ENANDES
- African Technical Workshop on Crop Models and coupling with Numerical Weather and Seasonal to Subseasonal Forecasts (June 2022)
- Workshop: Supporting Agricultural Services in identifying Satellite based products for Agrometeorological bulletins in Central Africa (November 2022)

Focus Area C

To measure the impact of WMO climate-related reports, WMO developed a methodology that combines quantitative data on online media mentions, and social media metrics with qualitative data on references in key policy documents, pickup of messages by fellow UN entities, use in speeches by UN Secretary-General, etc. The following annual reports were defined as "flagship" and included in the analysis: (1) State of the Global Climate (provisional and final reports); (2) State of Climate Services; (3) Greenhouse Gas Bulletin; (4) United in Science; and (5) Weather and Climate Extremes Archive (rolling). In 2021, (6) the Global Decadal to Annual Climate Update reports were added to the KPI.

Figure 1.8 presents the attention that the above WMO flagship products have received in online media (TV channels, newspapers, etc.), as tracked via software using automatic word detection. Clearly, the Greenhouse Gas Bulletin and the State of the Global Climate Provisional Report have consistently generated above average media mentions and account for the highest spikes in media interest. Though a one-off publication that is not regularly tracked as part of this monitoring indicator, the WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019) ranked as the second highest in terms of media mentions at the time of its launch in September 2021, only on a par with the State of the Global Climate Report. Apart from the successful press conference, the high level of interest may be explained by the extreme weather events of the preceding summer, which may have resonated with the report's content. In 2022, the Global Decadal to Annual Climate Update (2022-2026) released in May also performed excellently.

The State of the Global Climate Report is by far WMO's most referenced report, exceeding the reach and impact of all other flagship products. The report:

- Generates above average media attention, as shown on Figure 1.8.
- Achieved 1M+ impressions on Twitter in 2020 and 2021 (see Figure 1.10).
- Was specifically mentioned in the Glasgow Climate Pact as a welcomed WMO contribution.

In 2022, the report highlighted that the increase in atmospheric concentration of CO2 from 2019 to 2020 was slightly lower than that observed from 2018 to 2019, but higher than the average annual growth rate over the last decade. This is despite a decrease in fossil fuel CO2 emissions of approximately 5.6% in 2020 due to restrictions related to the COVID-19 pandemic. Moreover, the global mean temperature in 2021 was 1.11 ± 0.13 °C above the 1850–1900 average, and the year saw global mean sea level reaching a new record high, rising an average of 4.5 mm per year over the period 2013–2021

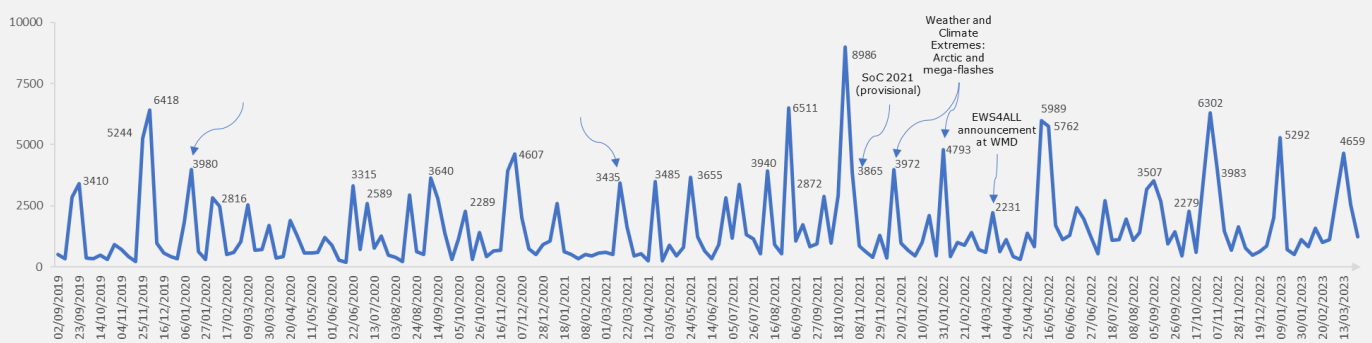


Figure 1.8 WMO global online media mentions, Meltwater Media Monitoring, April 2023

In addition to the 2022 Provisional Report launched at COP27, WMO published the State of Global Climate 2022 in April 2023. A series of annual regional reports were also developed to complement the report, inform regional policy decision-making and facilitate partnerships.

- Latin America and the Caribbean
- Asia
- Africa
- South-West Pacific
- Europe

As mentioned above, **the Greenhouse Gas Bulletin is among the top three WMO flagship reports mentioned in the media,** with a particularly good performance in 2021. Three bulletins were issued since 2020, which present the latest analysis of observations from the WMO Global Atmospheric Watch (GAW) Programme. The Bulletins demonstrated that the abundance of heat-trapping greenhouse gases in the atmosphere once again reached a new record in 2020. The annual rate of increase was above the 2011-2020 average. That trend has continued in 2021.

The record greenhouse gas levels are locking in increasing temperatures for decades to come. This will be accompanied by more extreme weather, including intense heat and rainfall, ice melt, sea-level rise and ocean acidification.

The amount of CO2 in the atmosphere is now nearly 150% of 1750. In 2021, it reached 415.7 parts per million (ppm), while methane level stood at 1908 parts per billion (ppb) and nitrous oxide at 334.5 ppb. These values constitute, respectively, 149%, 262% and 124% of pre-industrial levels before human activities started disrupting natural equilibrium of these gases in the atmosphere. It crossed the symbolic 400 ppm milestone only in 2015, so we are seeing a rate of increase which is unprecedented on the historical record.

In its latest edition (GHG Bulletin No. 18, 2022), the Bulletin reported the biggest year-on-year jump in methane concentrations in 2021 since systematic measurements began nearly 40 years ago. The reason for this exceptional increase is not yet clear, but seems to be a result of both biological and human-induced processes.

About half the CO2 emitted by human activities today remains in the atmosphere. The other half is taken up by oceans and land ecosystems.

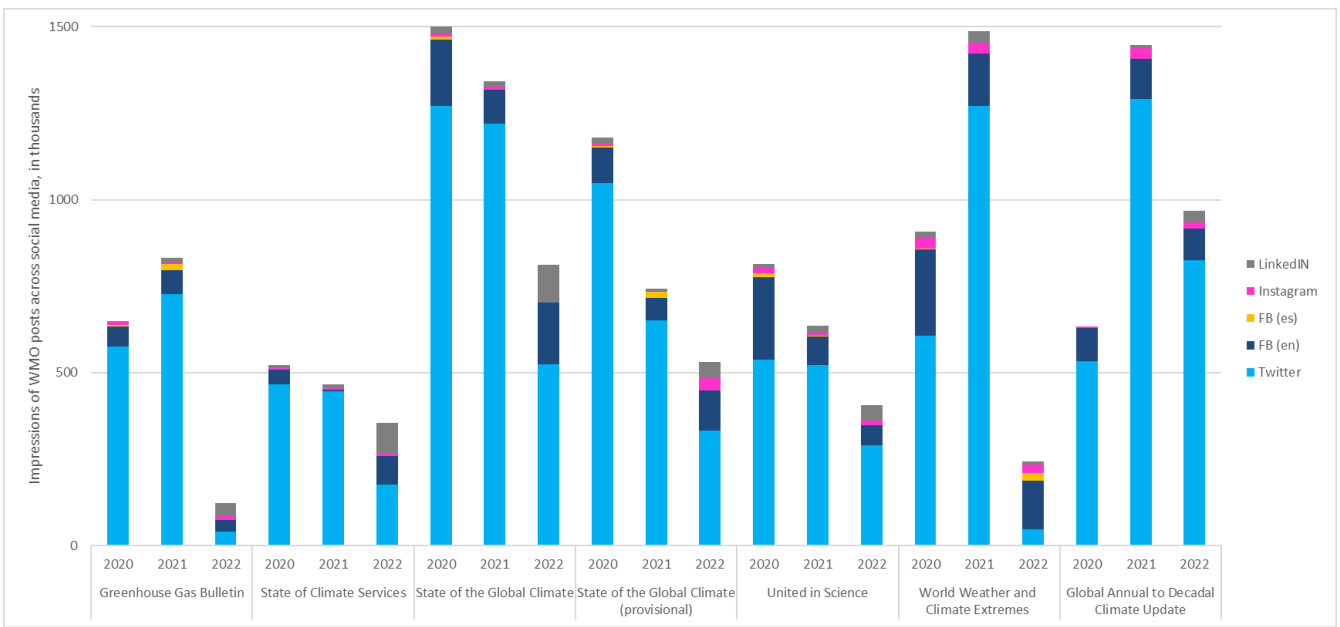


Figure 1.9 Social Media Outreach, Hootsuite Social Media Monitoring, Twitter Analytics, January 2023

United in Science Report

Since its launch in 2019, the new United in Science Reports have successfully gained a

stable audience, especially on Twitter, where they realize most of their reach. Looking back, their Twitter campaigns in 2020 and 2021 have generated very high likes-to-impressions ratios, indicating that their wording and associated media spur a lot of enthusiasm amongst users (Figure 1.10). Thus, they could be used as best practice examples to increase the engagement of other WMO products campaigns. While their Twitter launch campaigns have also been consistently supported and relayed by the

UNSG and UN accounts, they still could benefit from further promotion among other WMO partners. For more detail see LTG 3.

The Weather and Climate Extremes Archive provoked high interest in the media and social media, even producing the best performing WMO tweet ever on the likelihood of 1.5°C global warming in 2021. In comparison to other WMO flagship products, the archive was not featured as widely by other fellow UN entities.

WMO Climate Indicators

- Climate Indicators and Sustainable Development: demonstrating the interconnections (WMO-No. 1271) published.
- Highlights seven climate indicators whose impacts span the SDGs: carbon dioxide concentration, temperature, ocean acidification, ocean heat content, sea-ice extent, glacier mass balance, sea-level rise.
- Visually maps how the impacts on the global climate and the risks they pose to sustainable development will affect the achievement of specific SDGs.

Regional Climate Outlook Forums

Sustained efforts on RCOF v2.0 implementation in Africa, Asia, Pacific, Europe and the Americas, particularly in 10 sub-regions:

- South Asia; West Africa; East Africa; Caribbean; Pacific; Southeast Asia; Mediterranean; North Africa; Southeast Europe; Arctic.

WMO Regional Climate Centres

- Assessment of the status of climate data availability published for 8 RCCs and partners: RCC Caribbean (CIMH); Pacific RCC Network (SPREP, secretariat); RCCIOC; RCCSADC Climate Services Centre; RCCECCAS; RCCAGRHYMET; RCCICPAC; and RCC Africa (ACMAD).
- An evaluation of all aspects of RCCs/regional partners' operations conducted as well as a survey of NMHSs on the use of and requirements for RCC products and services. Sustained efforts to establish Antarctic RCC Network and Third Pole RCC Network, and to designate the following RCCs: Artic RCC, South East Asia RCC
- Scope and provisional structure of an RCC Network for Southwest Indian Ocean (SWIO RCC Network) defined

WMO Global Seasonal Climate Updates and El Niño/La Niña Updates

- Global Seasonal Climate Updates (GSCU) issued quarterly, with monthly interim updates
- El Niño/La Niña Southern Oscillation (ENSO) Bulletin issued quarterly.
- Monthly seasonal briefs submitted to the ENSO Global Cell of the Inter-Agency Standing Committee (IASC).

WMO Global Annual to Decadal Climate Updates (GADCU) published annually in May since 2020.

The State of Climate Services Report

was only first published in 2019 but achieved a clear upward trend in outreach in 2020-2022. It registered:

- A steady increase in online media mentions (from 2,289 in 2020 to 2,872 in 2021)
- A high retweet-to-impressions ratio, suggesting that it gets widely disseminated among WMO's community, though its total social media reach is still lower than that of other reports.

Three State of Climate Services reports were published in 2020-2022, each focused on a particular GFCS priority area: disaster risk reduction, water and energy. Since its launch in 2019, the capacity baseline analyses developed as part of the State of Climate Services reports supported WMO raise more than 100 M USD, through successful project proposals development. Figure 1.11. illustrates the various applications of the report, ranging from the development of NAPs and NMHS Strategic Plans to the design and implementation of projects to policy outreach and reporting. The report is largely based on the input provided by Members to the WMO Climate Service Checklist mentioned earlier.

Key findings and recommendations to improve climate services for adaptation from the reports include:

- Systematic observation and systems integration including the need for fit for purpose-financing to enable data and products to flow from countries to advanced data processing and forecasting centers and vice versa
- Co-development of decision-support products and services, access to services and the need for climate science basis
- Data on party adaptive capacities in the area of climate services is incomplete and the data that are available need to be quality assured as a basis for certification of climate services capacities.
- Adaptation finance for climate services remains inadequate, especially for meeting needs in LDCs and SIDS.
- More systematic documentation of the benefits of adaptation actions and the resulting improvements in adaptation outcomes is needed in order to ensure that the measures being financed are cost-effective and that progress towards the global adaptation goal is being achieved.

Forward perspective

The WMO Decadal Climate Report 2011-2020 will be published and released at UNFCCC-COP28 on the occasion of the Global Stock-take. It will highlight the changing status of the key climate indicators over the decade and demonstrate how weather and climate extremes have influenced the SDGs based on real world data.

Figure 1.10 Checklist for Climate Services Implementation Applications, WMO, 2022

Project Highlights:

Intra-ACP Climate Services and Related Applications Programme (ClimSA)

RA I, RA IV and RA V; funded by the EU; CHF 5.9 million (2020-202 6)

WMO technical guidance addresses observations, data, predictions, models and the mainstreaming of climate services into policy processes. Highlights of ClimSA achievements include:

- Climate Services Information System (CSIS): Developed a guidance document on Climate Services Information System (CSIS) core functions and operations at the regional level
- OpenSource CDMS: Developed a regional requirements document on OpenSource CDMS (annex available here)
- Guidance on objective seasonal forecasting for each ACP sub-region: Provided guidance on operational practices for objective seasonal forecasting for the Caribbean, Central Africa, Greater Horn of Africa, Pacific, South-west Indian Ocean, West African, and Southern African regions
- International Climate Assessment and Dataset System (ICA&D) for ACP RCCs: Developed a rationale for climate data sharing
- Regional assessments of climate services needs, capacities and existing sectoral platforms for user engagement: conducted sub-regional analyses for Southern, Eastern and South-west Indian Ocean regions of Africa; West and Central Africa regions (FR); Pacific region; Caribbean Region

Adaptation Fund | ENANDES

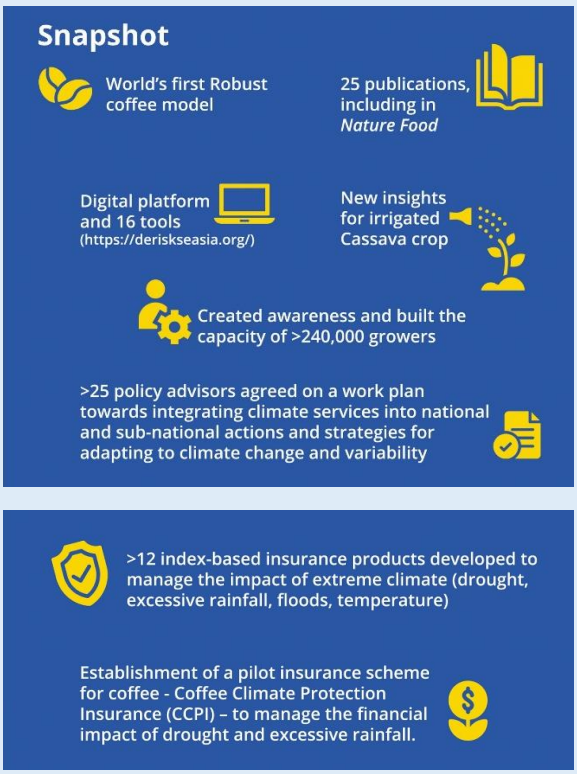
RAIII | | CHF 6.6 Mio | 2021-2025

Under the ENANDES Project, an Operational Manual to access and use the Data Library Map Room including the ELR-calibrated sub-seasonal forecasts was developed. Further, an assessment of data management systems in the NMHSs of Colombia, Chile and Peru was carried out with the goal to identify areas for improvement. Finally, several trainings have also been conducted as to the management of homogenized data (6 countries under the Regional Climate Center of West of South America) and on related tools such as the "Quality Control of Climatological Daily Time Series" (INQC) and "Climatol" for quality control and homogenization of daily series of precipitation and extreme temperatures, as well as INCLICS software for Crops Calendars estimation.

BMU | Applying Seasonal Climate Forecasting in Southeast Asia

RA II- | CHF 8.7 Mio | 2018-2022)

A Digital Platform and 16 different tools for climate forecasting were developed together with an analysis for agriculture climate services for the countries involved (Cambodia, Lao PDR, Myanmar, Vietnam). Additionally, 12 index-based insurance products to manage extreme climate hazards for Southeast Asia were developed. Finally, a pilot insurance scheme for coffee in Vietnam to manage financial impact of drought and excessive rainfall was established which will provide a strong support for local farmers.



Project Highlights:

European Union | Focus Africa

RA I | CHF 1.1 Mio (WMO component) | 2020-2024

Several reports were developed benefiting the Southern African Development Community (SADC) region and especially the countries involved (Malawi, Mauritius, Mozambique, South Africa, Tanzania). The reports refer to: the analysis of the predictability of seasonal and decadal forecasts, verification of seasonal forecasts, the characterization of climate projections and decadal predictions, and the selection and analysis of high-resolution climate projections of the region. FOCUS-Africa aims to deliver tailored climate services to increase resilience and adaptation in the SADC region in four key sectors: agriculture and food security, water, energy and infrastructure. The socio-economic baseline assessment was conducted for each of the case studies. Every country was also assessed with regards to the existing climate services, producing a climate services benchmark for the country, as well as a regional benchmark for each sector.

CREWS West Africa

RA I | CHF 4 Mio | 2018-2023

Under CREWS West Africa, 19 countries benefit from the enhancement of Regional Centers' capabilities for flash flood, severe weather and agrometeorological monitoring and forecasting. As part of the Monitoring and forecast of IntraSeasonal Variability over Africa (MISVA), national forecasters receive trainings and weekly briefings to make optimal use of the Real-time Monitoring and forecast of IntraSeasonal Variability to anticipate severe weather. The project further supported a climate watch advisories generator service (including the CM SAF satellite- and GPCC-based monitoring products for West Africa), enhanced the TAMSAT rainfall dataset for agrometeorological use, developed specific agrometeorological indices combining gridded datasets and station data made available in WIS, and supported NMHSs with training and advise from Casablanca Regional WIGOS Center

ACREI – Participatory Seasonal Advisory Development

Region I 6,800,000 The Adaptation Fund 2018-2022

The Agricultural Climate Resilience Enhancement Initiative (ACREI), through its partners FAO and the IGAD Climate Prediction and Application Center (ICPAC) is improving agroclimate advisories that allow farmers in targeted areas of Ethiopia, Kenya and Uganda to make informed agrometeorological decisions. The following are the achievements:

- Agromet staff of 3 NMHSs (Ethiopia, Kenya and Uganda) trained on R-Instat and PICSA approaches,
- Capacity on participatory seasonal climate advisory development in agriculture enhanced,
- Participatory seasonal climate advisories supported in project locations in target countries for every rainy season since 2019,
- Enhanced media engagement and partnership in project locations for communication of weather and climate information,
- Manual on climate sensitive farmer field schools developed and 62 farmer field schools (30 members each) supported with learning on climate resilient practices across the 3 countries,
- Assessment of extensions capacity on climate change conducted in project locations,
- 3 AWS procured and installed in project locations and IT equipment procured for agromet sections of NMHSs – 2 desktops each,
- Various good practices on climate services in agriculture documented: 1) participatory seasonal climate advisory development; 2) Seasonal Media Action Plan for engagement of media in communication of climate information.

Strategic Objective 1.3

Further develop services in support of **sustainable water management**

Outcome/Focus Area A:
Enable better access to improved hydrological services, forecasts and warnings for water resources, drought and flood risk management and planning.

#Flood forecasting #Integrated flood management #Global Drought Indicator #Water management for food security #Global Hydrometry Support Facility – WMO HydroHub #WMO Hydrological Observing System (WHOS) #World Hydrological Cycle Observing System (WHYCOS) #Meteorology, Climatology and Hydrology Database Management System (MCH) #World Water Data Initiative (WWDI)

Outcome/Focus Area B:
Facilitate the exchange of transboundary data and products through the Global Hydrological Status and Outlook System to enhance understanding of current and future water resources.

#HydroSOS

Outcome/Focus Area C:
Regular reporting on the state of global water resources.

#Regional Hydrological Fora #Water Resources Assessment

Overview

Strategic Objective 1.3

Further develop services in support of sustainable water management

SDG Contribution

ON TRACK

- WMO Vision and Strategy for Hydrology and Action Plan, WMO Water Declaration, and Hydrology Research Strategy adopted by Cg-Ext.
- 130 Members attended the Hydrology Assembly held during Cg-Ext
- Successful launch of the Water and Climate Coalition with high-level political interest.
- Improved regulations adopted: Amendments to Technical Regulations Volume III – Hydrology (WMO-No. 49),
- Improved guidance for integrated hydrology services developed: Guidelines on Seasonal Hydrological Prediction (WMO-No. 1274); Assessment of National Capabilities and Needs in End-to-End (E2E) Early Warning Systems for Flood Forecasting (WMO-No. 1286); Implementation of a Coastal Inundation Forecasting Early Warning System (WMO-No. 1293); Sustainability Strategy for FFGS.
- Key decisions approved: establishment of WMO Hydrological Centers in GDPFS, Global Drought Classification System, and implementation of the Common Alerting Protocol (CAP) for Hydrology
- Inventory for E2E Early Warning Systems for Flood Forecasting models and platforms created
- Community of Practice on Flood Forecasting launched and operationalized
- WHOS Global, WIGOS/WHOS-Plata and Arctic-HYCOS Portals as well as WHOS Community site launched
- Phase I of WMO HydroHub completed and Phase II initiated with a focus on increasing capacity, operationalizing innovation and optimizing engagement and investments
- Regional Hydrological Advisers Fora held on a quarterly basis across all regions

CONTINUED EFFORTS REQUIRED

- HydroSOS implementation, including the development of regional plans
- World Water Data Initiative to be accelerated
- WHOS/GDPFS to be made accessible from the SDG 6 Portal
- VOLTALARM Early Warning System being developed
- Cooperation and activities related to the Water Quality long-term ambition Support of SERCOM Expert Team on Drought (SC-AGR) to Hydrological Ambition Number 2: Everyone is prepared for drought.

On track

Continued efforts required

Limited progress

COVID-19 Impact

Challenges & Risks

Strategic Objective 1.3

Further develop services in support of sustainable water management

COVID-19 IMPACT

- Global and regional work was minimally affected, with governance body meetings, workshops and training taking place virtually to the extent possible. The inability to accommodate all time zones put some participants at a disadvantage. The level of engagement also tended to be lower as compared to face-to-face meetings.
- Delays in project implementation were experienced at the national level (e.g. inability to install and calibrate equipment related to the Nadi-CIASS in Fiji, hampered ability to collect data and conduct measurements due to travel restrictions, delays in data sharing).
- Developed and implemented online training materials related to projects (as opposed to the initially planned face-to-face workshops) to minimize delays in the planned activities.

CHALLENGES & RISKS

- Reliance on voluntary contributions poses challenges to ensuring sustainability of activities (e.g. FFGS)
- Some tasks might not be covered to satisfaction due to lack of staff

SDG Contribution

On track

Continued efforts required

Limited progress

COVID-19 Impact

Challenges & Risks

Focus Area A

Flood Forecasting and Early Warning Systems

Figure 1.12 shows a steady increase in the provision of flood forecasting and warning services: 41% of Members are providing riverine floods (15% year-to-year increase globally), while 30% have operational flash floods forecasting and warning services (13% year-to-year increase). As such, the KPI is progressing on track with current objectives (i.e. WMO Vision and Strategy for Hydrology and its associated Plan of Action – outputs related to the Long-Term Ambition "No one is surprised by a Flood") to see all Members operating flood forecasting and warning services by 2030.

To address the issues associated with flash floods, especially the lack of capacity to develop effective flash flood warnings, the Flash Flood Guidance System (FFGS), a USAID and CREWS-funded initiative, was designed and developed for interactive use by meteorological and hydrological forecasters throughout the world. The following are some of its key achievements in 2020-22:

- South Asia FFGS was launched in Bangladesh, Bhutan, India , Nepal, and Sri Lanka;
- 1,000 forecasters participated in online training events provided by 5 FFGS Regional Centres (El Salvador, India, Pakistan, South Africa and Türkiye);
- An online learning FFGS platform developed, providing hands-on training material, regional forums, case studies and online courses;
- A flash flood app developed by the Turkish State Meteorological Service (TSMS) for Southeastern Europe, generating e-mail and mobile phone alerts for forecasters once the South East Europe Flash Flood Guidance System indicates positive flash flood threats;
- In South Asia, South Africa Region and the Hispanola Island, NWP model outputs from SWFP integrated into the regional FFGSs, based on which flash flood threat and risk products were computed;
- FFGS sustainability strategy approved by Cg-Ext (2021);
- FFGS Vision 2030 workshop held virtually in November 2021, with participation of 140 forecasters from 50 countries;
- FFGS training platform and simulator developed.

West Africa FFGS in Burkina Faso, Mali and Niger is under implementation by CREWS West Africa, with initial delineation and quality control completed, FTP accounts set up for each country to transfer real time and historical data, and a cooperation agreement with the two Regional Centers, ANACIM and AGRHYMET signed.

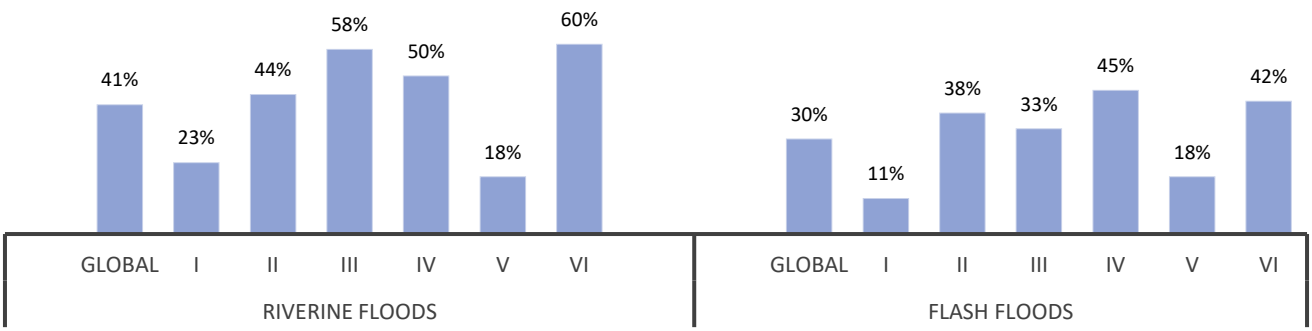


Figure 1.12 Percentage of Members with operational flood forecasting and warning services, Hydro Survey 2021

In the context of provision of support for improved flood forecasting related practices, the WMO Flood Forecasting Initiative - Advisory Group (FFI-AG) continued to provide guidance and advice on the hydrological forecasting elements of flood-related initiatives and programmes (i.e. SWFP, FFGS, CIFI, CHAMP, etc.). This Advisory Group also aims to provide broad-based support to improve collaboration between the meteorological and hydrological communities and disaster managers, active in flood emergency preparedness and response.

In the framework of the Standing Committee on Hydrological Services, the Community of Practice on End-to-end Flood Forecasting was created to support Members in the exchange of practices, in line with the philosophy of integrated flood management and open-source technologies. A web portal was set up, linked to the Associated Programme on Flood Management (APFM) and its already available resources, to ensure wider participation from both WMO and GWP networks.

On the occasion of APFM's 20th anniversary, a communication strategy was formulated to increase its visibility and augment the outreach of the guidance material accessible from its website. The HelpDesk on Integrated Flood Management continues to be operational and fulfilled more than 500 requests since its launch.

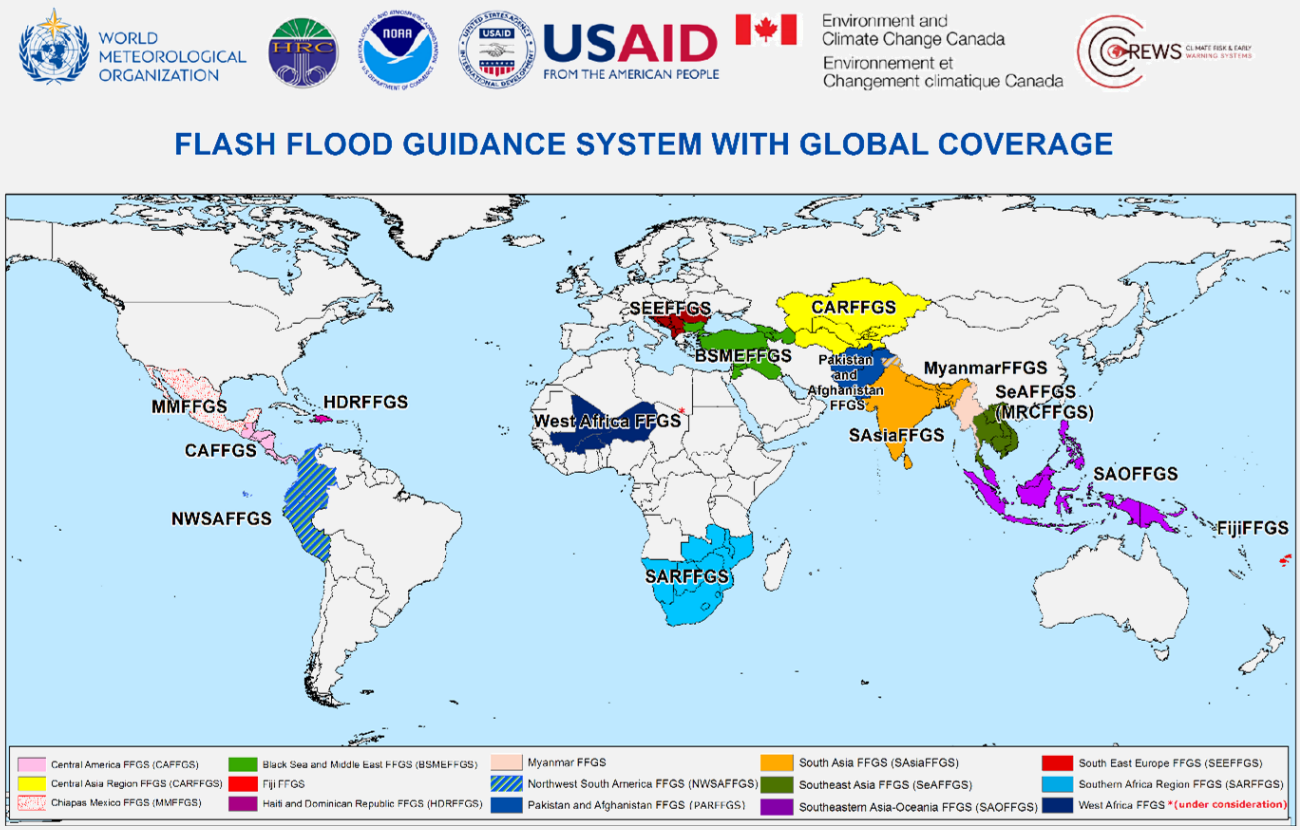


Figure 1.13 Map showing the FFGS Projects with Global Coverage, FFGS Portal, status in 2020

Hydro-climate and meteorological data support the food security agenda

Several activities related to SC-AGR deliverables on agricultural meteorology with the following outputs:

- Guidance on Applications of NWP and S2S forecasts for Agriculture in developing climate risk insurance products and coupling weather/climate models with agricultural bio-economic;
- Report Quantifying the impacts of particulate matter on crop yield: A synthesis of current knowledge;
- Report on Tropospheric Ozone impacts in agricultural production;
- Development of simple online database for tracking flux measurements in agricultural systems;
- Updated list of agrometeorological universities and textbooks included in Agricultural Meteorological Practices (WMO-No. 134) .

Drought Risk Management and Early Warning Systems

Drought is an insidious natural hazard which can occur in any global climate regime. Drought impacts can be significant and widespread, affecting many economic sectors and people at any one time. The issue of **quantifying loss and damage from extreme climate events such as droughts has become important for policy implementation**, especially with regard to the UNFCCC agenda, while improved drought monitoring and management is crucial to implementing the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Sustainable Development Goals.

Building upon the work from the Handbook on Drought Indicators and Indices (WMO-No. 1173), a Global Drought Classification System (GDCS) was approved by EC-73, which will allow the incorporation of national drought alerts and warnings into GMAS and HydroSOS.

In practice, drought warning systems show good progression across the globe (+10% year-to-year), with the largest increases observed in Region I (+13%), III (+33%) and IV (+27%).

More positive developments are expected in Region II where a drought management project proposal is being developed with the ultimate goal of covering the whole of Central Asia by building local peer-to-peer communities and increasing capacity.

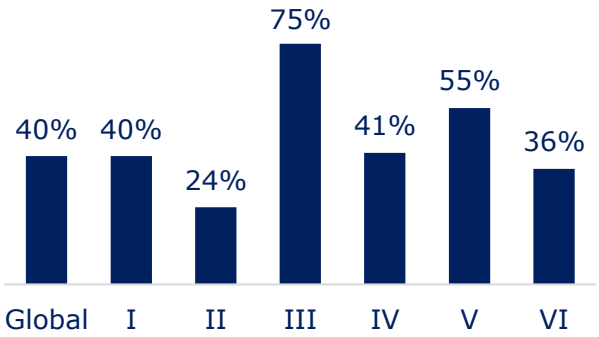


Figure 1.14 Percentage of Members with operational drought warning system, Hydro Survey 2021

Forward perspective

This evolution faces similar conditions to flood forecasting and warning services mentioned above: as the reserve of first adopters eventually dries out, the progression rate is expected to decrease in the future.

Key developments expected by the end of 2023 include the development of training material on integrated drought management and the development of an Implementation Plan on Global Drought Classification System. The latter should be connected to GMAS and HydroSOS in the medium term.

Hydrometry: data collection, management and sharing

In collaboration with the National Research Council of Italy , WMO implemented the WMO Hydrological Observing System (WHOS) in the La Plata Basin and the Arctic region as well as in the Dominican Republic, which led to 13 countries (Argentina, Bolivia, Brazil, Canada, Denmark, Finland, Iceland, Norway, Paraguay, Russian Federation, Sweden, Uruguay, USA) freely exchanging and using hydromet data across their boundaries. The implementation of WHOS also resulted in improved data and metadata models in participating institutions. This, in turn, enables interoperability and fosters trust between stakeholders. More details on WHOS benefits are available in the WHOS La Plata Basin case study.

In 2021, WMO further launched the WHOS Community Site and three WHOS data portals (WHOS-Global, WHOS-Arctic, WHOS-Plata), which allow users to easily leverage common WHOS functionalities, such as data discovery and data access, on the web by means of common web browsers. A Distance Learning course "Interoperable data exchange in hydrology" which includes a section on WHOS Architecture, Functionalities and Implementation, was developed in 2021. The development of API to upload multiple stations is ongoing.

The NMHSs of 10 countries (El Salvador, Gambia, Ghana, Guatemala, Guyana, Haiti, Honduras, Kazakhstan, Myanmar, North Macedonia) started to operationally use the WMO Meteorological, Climatological and Hydrological Database Management System (MCH), thus reducing the amount of staff time spent managing data, allowing to analyze and transform data into a valuable resource, and improving the quality and consistency of information.

Three workshops on MCH were also conducted to foster capacity development with 15 participants in Myanmar, 15 participants in Haiti and 17 participants from Central Asia in Kazakhstan . Furthermore, technical assistance/guidance on the installation and use of MCH was provided to the Departamento Provincial de Aguas (DPA), Provincia de Río Negro, Argentina, Sierra Leone, Democratic Republic of the Congo and New Caledonia.

Operational hydrology

Four distance Learning courses were held in the reporting period, of which three for the first time in languages other than English:

- The first remote training course in hydrology in Russian for specialists from the National Hydrometeorological Services of RA II and VI countries in April and May, with 33 participants of which 26 completed the course successfully.
- The 4th International Distance Learning Course on Advanced Topics in Hydraulics, Hydrological Sciences and Hydrometeorology for RA-II in June-July 2021, with 89 participants of which 77 completed the course successfully.
- The Flood Analysis, Modeling, and Forecasting for Stakeholders of the Volta River Basin from September to November, in French and English, with 78 participants of which 39 completed the course successfully.
- A 7-week distance learning course in French and English for RA I Hydrology Technicians in October-November 2022, with 62 participants.

Forward perspective

WMO aims at doubling WHOS implementation by the end of 2023.

Focus Area B

HydroSOS

HydroSOS is a global operational system aiming to regularly report the current global hydrological status, including groundwater, river flow, lakes and soil moisture, an appraisal of where the current status is significantly different from 'normal,' ex. indicating potential drought and flood situations; and an assessment of whether this is likely to get better or worse over coming weeks and months. Hydrological information, including relevant status and outlook products, are required to address sustainable development, adaptation to climate change, and disaster risk reduction efforts.

The HydroSOS methodology was developed by a team of 50+ experts from 17 NMHS across the six WMO Regions, nine research/scientific institutions in seven countries, three regional organizations in Africa, and four international organizations, and it is being now integrated in Regional Associations' implementation plans. Moreover, HydroSOS activities are being added to hydrological components of larger projects, for example CREWS and the Adaptation Fund.

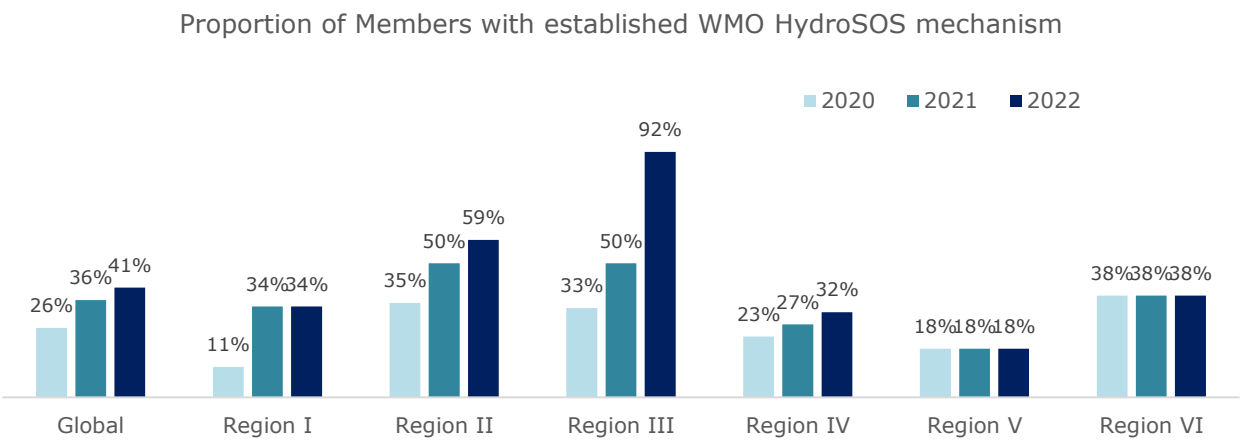


Figure 1.15 Proportion of Members contributing to the development of HydroSOS, WMO Secretariat 2021

79 WMO Members (41%) are formally engaged with the HydroSOS initiative and have provided inputs to the development of the system, such as by performing national assessments or providing relevant case studies (Fig 1.15).

Early implementation stages are ongoing in all regions, specifically in terms of the development of Regional HydroSOS implementation plans. WMO is currently working together with 23 Members (7 in RA I, 6 in RA II, 3 in RA III, and 7 in RA IV) on inception activities for HydroSOS under different projects and developing project proposals.

HydroSOS Demonstrator portal was launched, showcasing the HydroSOS global platform concept and benefits to WMO Members. The prototype is designed to trial possible ways in which hydrological information products could be integrated, and to provide an opportunity to identify and consider key design and scope decisions, yielding pragmatic insights as to the effort that will be needed to move from a prototype demonstrator to a fully operational system. The HydroSOS Demonstrator development report was also published.

Cg-Ext (2021) further approved the HydroSOS End-of-Pilot-Phase report.

Forward perspective

With this groundwork set up, Cg-Ext approved moving from a pilot stage into full implementation of HydroSOS in the coming years. The programme faces two main risks. First, lack of sufficient financial support might prevent implementation from ramping up, which would bar the programme from delivering its full benefits. Second, the Regional Association Management Groups should link with and support the HydroSOS Regional Implementation Groups to safeguard implementation and ensure sustainability.

Regional HydroSOS implementation plans have ben developed in the six WMO regions with the involvement of Hydrological Advisers, and are going to be presented to Cg-19 for their endorsement.

Focus Area C

Water Resources Assessment

WMO launched the Dynamic Water Assessment Tool (DWAT) to assist long-term planning and policy assessment and development. This tool is intended to help users, particularly policy specialists and water resource managers, identify current and future water management challenges and compare those with current and past water resources availability. It can also help better understand the impacts of past and present water management practices on water resources, as well as the interactions between climate, water and landscape. Members can download the software and manual for free and run multiple scenarios and simulations of catchment behaviour.

Two Global DWAT workshops were organized in 2021-2022 to share the results of assessments, understand how the tool can be applied under different basin characteristics and showcase DWAT functionalities. The workshops welcomed more than 80 participants across all WMO Regions. The DWAT team is currently working on version 1.3 of the tool, update of the manual, and development of training and communications materials.

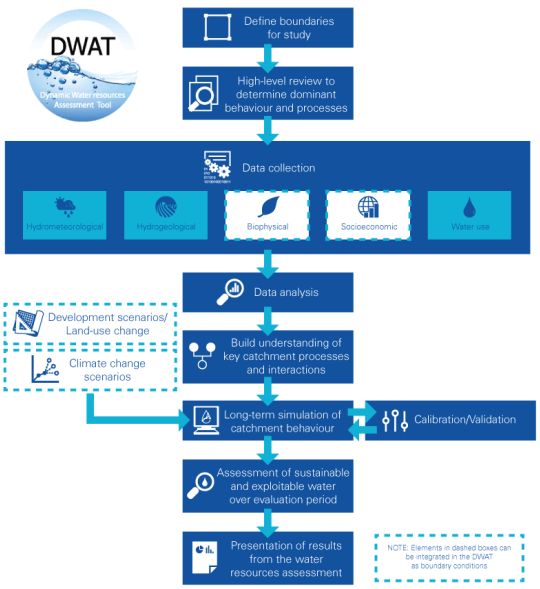


Figure 1.16 Dynamic Water Assessment Tool, WMO public website, 2022

A Water Resources Assessment webpage (including DWAT and other tools) was further developed in 2022 with the lead of SC-HYD, in cooperation with JET-HYDMON. The main goal of this webpage is to assist National Hydrological Services in implementing Water Resources Assessment by providing an evolving toolkit of appropriate and adaptable techniques that are consistent with their needs and capabilities.

Regional Hydrological Fora

Despite the challenges incurred by the Covid-19 pandemic, Regional Hydrological Fora took place on a quarterly basis in 2020-2022 across all regions. In effect, the virtual format provided an opportunity for broader participation, which reached double and sometimes triple the attendance observed in previous face-to-face meetings.

The Fora proved instrumental in engaging the hydrological community and identifying regional priorities, and further achieved linkages with countries and good entry points for future work. A positive effect was also observed in an increased number of Members with designated Hydrological Advisors. Currently 122 Members have designated Hydrological Advisers according to the modalities indicated in General Regulation 5(b).

Forward perspective

In the medium term, emerging needs include the development of material on water quality and the establishment of generic production processes, assessment methods, metrics and guidelines for hydrological information. The need to create a Community of Practice on water quality is also coming to the fore.

Project Highlights:

IDB | WMO HydroHub Phase II

RA IV | CHF 300.000 | 2020-2022

Under this project, Costa Rica and Panama have generated roadmaps for strengthening hydrological and meteorological services for water resources. In the case of Panama, the assessments have been critical in the development of their new NMHS. In Costa Rica, the assessments have provided inputs to the National Hydrological Meteorological Council (CONAHyMET). The roadmaps will further help both countries to identify where significant efforts are required in terms of capacities and investments and what activities should be prioritized. It will additionally help outreach to potential donors for future investments.

SDC | WMO HydroHub Phase II | 2021-2022

Region II – for project value and donor see SO 1.1 – 2017-2021

The WMO HydroHub Phase II kicked off in September 2021 for a period of five years, with the financial support of the Swiss Agency for Development and Cooperation (SDC) and the Inter-American Development Bank (IDB).

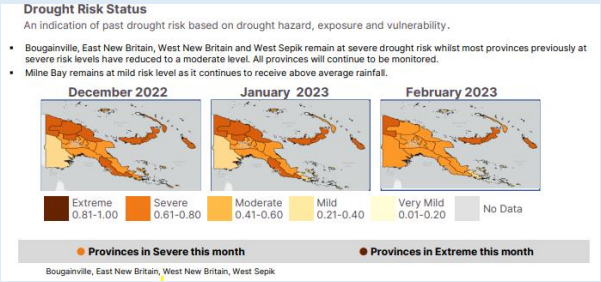
The objective of WMO HydroHub Phase II is to further support NMHSs with hydrological monitoring the effective delivery of hydrological services aimed at disaster risk reduction, social and economic development, and environmental protection. To do so, the following three outcomes have been identified: 1) increasing capacity; 2) operationalizing innovation; and 3) optimizing engagements and investments. The following activities were implemented in 2022:

- The Innovation Workshop "WMO HydroHub Phase II Innovation Roadmap" – which helped identify key innovation areas for support;
- The WMO HydroHub Innovation Call in the Pacific: awarded to the National Institute of Water and Atmospheric Research (NIWA) of New Zealand to implement a project titled "Non-contact measurement of river flows in the Pacific region, using innovative surface image velocimetry and stereoscopic methods."

CREWS | Papua New Guinea

RA V | CHF 1.6 Mio | 2018-2023

Under this project, Papua New Guinea (PNG) generates monthly drought maps that allow the monitoring and update of the Drought Early Warning Status in support of decision making in the agriculture sector. Furthermore, the twinning with the Australian Bureau of Meteorology successfully continues, which ensures PNG's access to new, high-quality Numerical Weather Products . The bulletins are also archived on the World Agrometeorological Information System (WAMIS- http://www.wamis.org/countries/png.php).



CREWS Caribbean

RAIV | CHF 2.2 Mio (WMO component) | 2012-2023

Under this initiative, the response capability to flood-related risk information and warnings in Antigua and Barbuda was improved through increased coordination between NHMSs, Disaster Risk Management authorities and other relevant authorities at the national and community levels. Activities implemented by WMO in joint collaboration with the National Office of Disaster Services included a Flood Management and Awareness Workshop, a Regional Gender Mainstreaming into Early Warning Systems for Integrated Flood Risk Management Workshop, a First-Aid Workshop, a media training, flood markings on vulnerable houses, update of vulnerable housing maps and simulation exercises. The activities focused on four selected flood-prone communities. This will strengthen the translation and communication of hydro-meteorological impact-based warnings to vulnerable communities and enable early action measures.

Project Highlights:

USAID | Flash Flood Guidance System (FFGS)

Global | CHF 9.1 Mio | 2019-2023

In line with the Project's sustainability strategy, previously implemented activities are sustained, especially the services of the Regional and Global Centres through integrating the WMO Global Data Processing and Forecasting System (GDPFS), hardware and software delivered South Asia Oceania FFGS and strengthening the response to the flash floods. Several activities were implemented in collaboration with FFGS partners and NMHSs, such as: enhancement of the Central Asia FFGS with Riverine Routing and Seasonal to sub seasonal forecast including Afghanistan, South Asia FFGS enhancement with Landslide and Urban modules for Delhi and Pakistan, Afghanistan FFGS enhancement with a landslide module and an urban module for Islamabad, Haiti and Dominican Republic FFGS enhancement with a landslide module are under development.

Further an automatic bulletin report tool and web application interface, including capacity building for three regional FFGS systems have been developed, which enables quick creations of the Flash Flood Guidance (FFG) Bulletins.

Volta Flood and Drought Management (VFDM) Project

Region I – 7,920,000 USD – The Adaptation Fund – 2019-2023

The VFDM Project has the ambition to provide the first large scale and transboundary implementation of Integrated Flood and Drought Management strategies through the complete chain of End-to-End Early Warning System for Flood Forecasting and Drought Prediction. The project is aimed to empower the NMHSs and other competent authorities of the six countries (Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali and Togo) with robust and innovative solutions for disaster risk reduction and climate change adaptation, including capacity development for nature-based solutions and gender-sensitive participatory approaches.

18 hybrid (virtual and face-to-face) national training workshops were conducted with 60 technicians for developing flood and drought risk maps and 1 regional and 6 national workshops were conducted to present the risk maps and climate scenarios for developing recommendations for risk prevention and management strategies

8 National workshops (with more than 200 participants) were organized on mainstreaming gender into End-to-End Early Warning System for flood forecasting (E2E-EWS-FF) and Integrated Flood Management (IFM)

6 National training workshops (supporting 150 national participants) conducted on nature-based solutions for flood and drought management and development of bankable projects on Nature-based solutions

More than 200 participants from the Volta Basin participated in the distance learning organized on basic and advanced hydrology and geo-spatial information technology for flood and drought management

15 participants from the Volta Basin countries successfully completed the distance learning course on Hydrological field measurements organized by the WMO

More than 100 participants from the Volta Basin participated in the distance learning course on drought monitoring and EWS organized by WMO IDMP programme and Cap-Net

One virtual and two hybrid training workshops were conducted for the NMHSs and other national and regional stakeholders (21 participants) of the Six countries on VOLTALARM EWS for its operational use.

17 participants from Ghana were trained on WMO Meteorological Climatological and Hydrological (MCH) Database for its installation, storage of data and on day-to-day usage. Similar training is planned for the 5 French countries in June 2023

Strategic Objective 1.4

Enhance the value and innovate the provision of **decision-supporting weather information and services**

Outcome/Focus Area A:

Enhance the value and innovate the provision of decision-supporting weather information and services

#Impact-based forecasting #Aeronautical meteorological services #Marine meteorological and coastal services #Service delivery to polar and high mountain regions #Strengthened communication capacity of NMHSs to provide services to National Disaster Management Agencies and public

Outcome/Focus Area B:

Design and implement new weather and water prediction services for the specific needs of megacities and other urban areas

#Pilot integrated operational platforms for urban service delivery #Enhanced provision of decision support services to land transportation

Outcome/Focus Area C:

Provide NMHSs with further guidance and assistance in the assessment and enhancement of socioeconomic benefits of their services

#Strengthened capacity of Members to conduct socio-economic benefit assessment

Outcome/Focus Area D:

Establish principles and guidance for successful public-private engagement, and facilitate a continuous dialogue between players and stakeholders based on collaboration and mutual reinforcement

#High-Level Roundtable #Analytical studies #Raised awareness of Members #National assistance and consultations #Dialogue with stakeholders

Outcome/Focus Area E:

Develop and adopt international standards, quality control mechanisms and recommended practices in a holistic manner for all service areas based on best national practices

#Compliance with technical regulations (aviation, marine) #Maintenance of standards #Guidelines, manuals and good practice #WMO Strategy for Service Delivery

Strategic Objective 1.4

Enhance the value and innovate the provision of decision-supporting weather information and services

SDG Contribution

ON TRACK

- **Panel on Socioeconomic Benefits** established (see Focus Area C)
- Development and updates of regulatory and guidance material on marine meteorological and oceanographic services:
  - **Maritime safety material**: Manual and Guide for Marine Meteorological Services (WMO-No 558 and 471); Sea Ice Information and Services (WMO-No.574); WMO No 9 Vol D. Information for Shipping and WMO contributions to several technical documents of the International Maritime Organization (IMO).
  - **Coastal material**: Revision of WMO. No 1076, Guide to Storm Surge Forecasting; and the new publication WMO.1293 CIF Guidelines.
  - **Marine Services Cost Options investigation** – the results are being presented to Cg-19.
  - WMO-IMO Worldwide Met-Ocean Information and Warning Service **portal updated** (hosted by Météo-France)
  - See more in Focus Area E
- Development and updates of regulatory and guidance material on aeronautical meteorological services
  - **Volume I, General Meteorological Standards and Recommended Practices** (WMO-No. 49) and **Compendium of WMO Competency Frameworks** (WMO-No. 1209) addressing the qualification and competency requirements of aeronautical meteorological personnel [for Cg-19 adoption]
  - **Volume II, Meteorological Service for International Air Navigation** (WMO-No. 49) to align with Amendments 79 and 80 of International Civil Aviation Organization (ICAO) Annex 3
  - **Plan of action for the discontinuation of WMO-No. 49**, Volume II, Meteorological Service for International Air Navigation [for Cg-19 approval]
  - See more in Focus Area E
- **Capacity development** and **strengthened partnerships** on marine and aeronautical meteorological services (see Focus Area E)
- **300+ experts trained** in 9 workshops on severe weather and impact-based forecast and warning services (see more in Focus Area A)
- **Public private engagement**
  - **Guidelines for Public-private Engagement (WMO-No. 1258)** and two White Papers published
  - Two High-Level Sessions of the **Open Consultative Platform (OCP)** organized
  - **Two Regional Fora** on Public-Private Engagement held
  - Consultations and innovation webinars/workshops
  - See more in Focus Area D

On track

Continued efforts required

Limited progress

COVID-19 Impact

Challenges & Risks

Strategic Objective 1.4

Enhance the value and innovate the provision of decision-supporting weather information and services

SDG Contribution

CONTINUED EFFORTS REQUIRED

- Strengthened **marine service delivery** in regional contexts
- Strengthened capacity development and implementation of **marine weather competencies**
- Strengthened development of **ocean forecasting and prediction services**
- Strengthened development of **WMO-led S-100 based product specifications**
- Development of pilots on **integrated operational platforms for urban service delivery**
- Service delivery to **polar and high mountain regions**
- Integrated services for **land transportation**

COVID-19 IMPACT

- Delays in establishing several expert teams, particularly in **marine services**.
- The inability to conduct face-to-face meetings, especially in 2020 and 2021, posed challenges to keeping experts engaged. There were evident signs of **virtual meeting fatigue and generally lower level of engagement** amongst some of the experts involved, in addition to multiple turnovers of experts, especially as people move on to new positions.
- Substantial **increase in the number of virtual meetings convened** (in lieu of in-person physical meetings), often outside of normal working hours, placing immense demands on the Secretariat and experts alike.
- COVID-19 fortunately had **limited impact on delivery of METAREA services** due to contingency plans in place between neighbouring METAREAS, and with NAVAREAS.

CHALLENGES & RISKS

- Members **compliance** (lack thereof) with technical regulations.
- General lack of **national platforms** bringing together the public sector, private sector and academia.
- Only few Members conduct assessments of the **socio-economic benefits** of weather and climate services.
- Implementation of **Quality Management Systems** for aeronautical meteorological services, marine services and early-warning services.
- **Access and availability of experts** to support the work, and funds to carry out the broad range of activities required to strengthen the delivery of marine services in Members.

On track

Continued efforts required

Limited progress

COVID-19 Impact

Challenges & Risks

Focus Area A

300+ experts including over 90 women from East Africa, West and Central Africa, Southern Africa, South and Southeast Asia, Eastern Caribbean and South Pacific were trained in the course of 9 workshops on severe weather and impact-based forecast and warning services during 2021-2022. The trainings focused on the interpretation of numerical weather prediction, the use of ensemble prediction system outputs, the use of satellite-based information to help with nowcasting severe and high impact weather events and a session on understanding the needs of users and sectors to develop a forecast-based early action approach.

Focus Area B

Of the 105 Members that provided data on service provision, only 15 provide integrated urban services, most of which are from Regions II and VI. None of the NMHSs in Regions III and V have indicated the provision of such services.

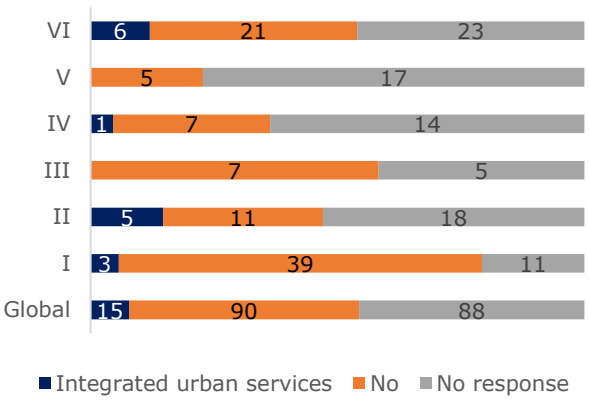
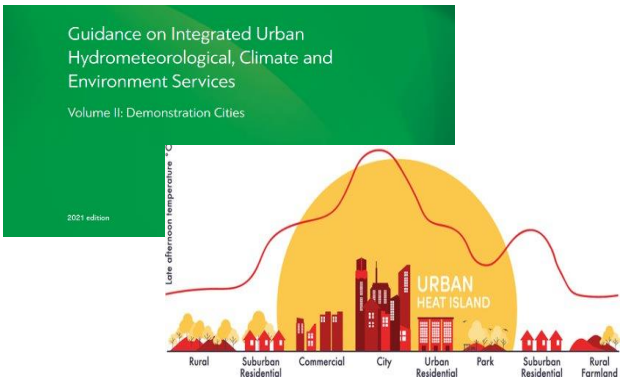


Fig 1.17 Number of Members providing integrated urban services, WMO Monitoring, December 2021.

Study Group on Integrated Urban Services (SG-URB) was established under SERCOM with the following priorities (see also LTG 3):

- Stakeholder mapping and roadmap on stakeholder engagement
- Development of the Implementation Plan for the Integrated Urban Services
- Development of the good practices document on approaches to very high-resolution forecasting, predictions, and warning systems



Guidance material developed:

- Guidance on Integrated Urban Hydrometeorological, Climate and Environment Services, Volume II: Demonstration Cities (WMO-No. 1234) published.
- Enhancements being developed, particularly on high resolution forecasting, impact-based forecasting, and stakeholder mapping.

Focus Area C

Socioeconomic benefits of improved weather and climate prediction are underestimated by many governments, especially in developing countries, resulting in insufficient investments along the entire value chain of weather, climate and hydrological services. Despite a widespread recognition of the role that NMHSs play in national economies, **the tracking and reporting of socioeconomic outcomes remains inconsistent and weak across all regions**. As of December 2021, only 34 Members (or 18% of the total) reported such analysis, most of which were from Regions I, II and VI. Most have provided a reference to a document or a link, on which further data quality assurance is required. The full regional perspective is presented on Figure 1.18.

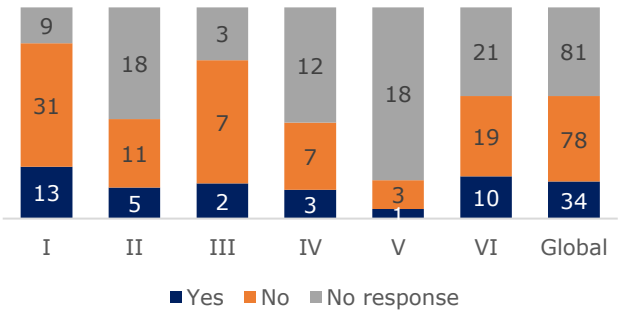


Figure 1.18 Number of Members that have conducted socio-economic benefit studies in the past 10 years, WMO Monitoring, December 2021.

In addressing these challenges, the **Panel on Socioeconomic Benefits (PSB)** was established by EC-75 to elucidate economic and societal costs of extreme events as well as benefits from investments into observational infrastructures, early warning and services to the public and governments. The Panel consists of representatives from international organizations, including UN regional commissions, development banks, NMHS and academia, among others. One of the Panel's main objectives is to support the development of a WMO Socio-Economic Benefits (SEB) Toolbox and a SEB Toolbox Training Package which aim at strengthening the capacity of WMO Members. The methodological basis for the SEB Toolbox is formed by completed and ongoing SEB assessments as part of project deliverables. Examples include:

- CREWS Burkina Faso Project, SEB assessment completed;
- High Impact Weather Lake System (HIGHWAY) Project, SEB assessment completed;
- Fully Optimized User Centric Climate Services Value Chain for Southern Africa Project (FOCUS-Africa), SEB assessment ongoing;
- Enhancing Adaptive Capacity of Andean Communities through Climate Services Project (ENANDES), SEB assessment ongoing.

Focus Area D

Of the 77 Members with legislation on the participation of the private sector in the provision of information and services along the value chain, over half characterize it as 'constrained' (i.e. allowed under certain conditions, such as licensing). **The private sector can provide services unconditionally in 18 countries and territories globally**, a large portion of which are in Regions I and VI. The participation of non-NMHS entities is banned by 13 Members around the world, half of which are in Region I. Thirty-three Members have no legislation on the subject.

Out of 114 Members that provided information on this topic, 61 (54%) describe a growing trend in the provision of services by the private sector, whereas 40% see no noticeable change.

Provision of services by the private sector

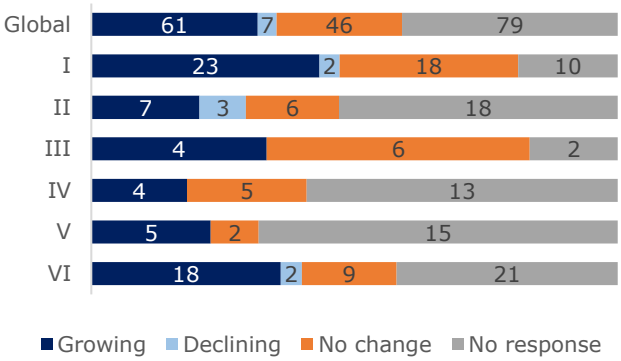
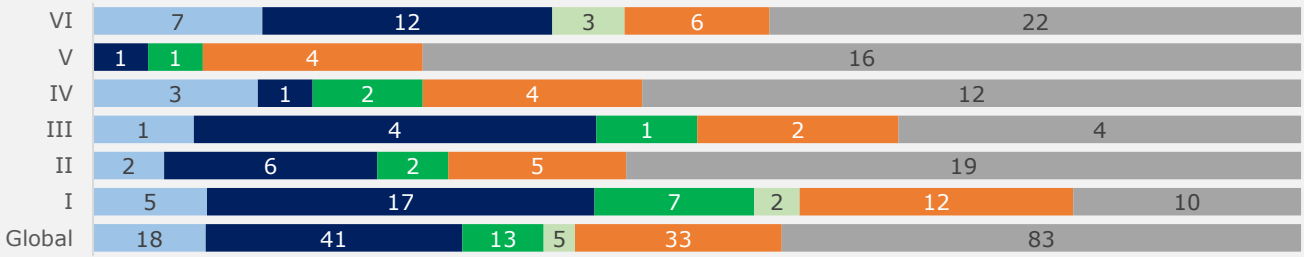


Fig 1.19 Provision of Services by private sector, WMO Monitoring, December 2021.

Number of Members with the following types of legislation for Private-Public-Engagement



Permissive (Allows private sector participation in service provision without any specific conditions)

Constrained (Allows private sector participation under certain conditions, such as licensing. NMS has a well-defined role including as "authoritative voice" of warning services)

Prohibitive (Does not allow any participation of non-NMS entities in the provision of information and services, NMS is the sole provider)

Other (existing legal basis does not fit the above categories)

No specific legislation (concerning the provision of information and services); Permissive (Allows private sector participation in service provision without any specific conditions)

Figure 1.20 Public Private Engagement Legislation, WMO Monitoring, December 2021.

Figure 1.21 presents the number of Members with formal agreements between the public and private sector. The majority tend to be on service provision and a slightly lower proportion on observation data and the operation and maintenance of networks.

25% of Members have a multi-sector consultative platform established to foster dialogue among the public, private, civil society sector and academia (see Figure 1.22). Meetings are reported to take place at least once or more times a year. **For two-thirds of Members with such platforms, the main organizer is the NMHS.**

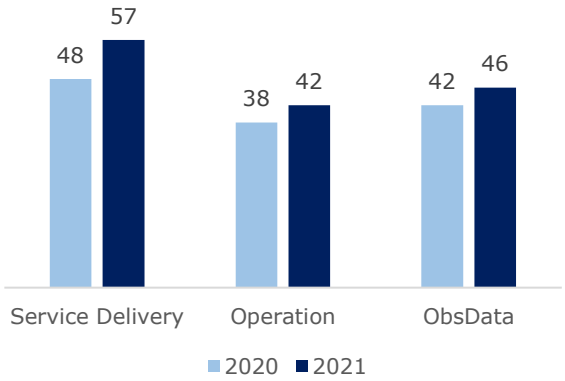


Figure 1.21 Number of Members with formal agreements between public and private sector, WMO Monitoring, December 2021.

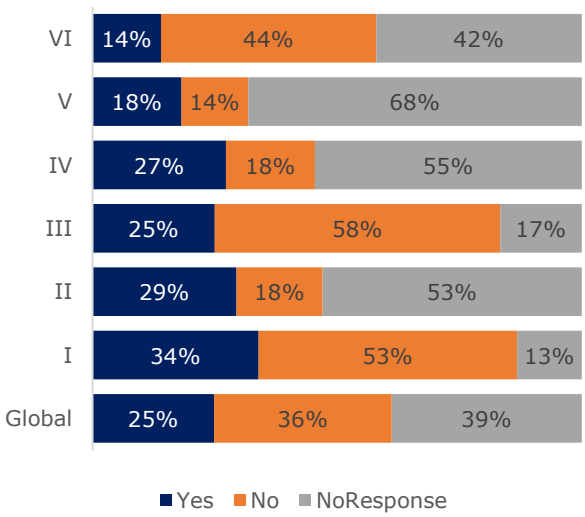


Figure 1.22 – Percentage of Members with a multi-sector consultative platform to foster regular cooperative dialogue, WMO Monitoring, December 2021.

Guidelines for Public-Private Engagement (WMO-No. 1258) published

- Aimed to **inform and facilitate global, regional and national actions** by WMO and its Members towards proactive engagement between the public, private and academic sectors.
- Outline and promote principles aimed at maximizing the benefits of an **inclusive weather enterprise approach**.
- Provide background information on the **evolution of the WMO policy** and the **proposed transformation of the PPE Policy Framework**.

Two White Papers published

- **White Paper #1 on the Future of weather and climate forecasting**: traces the development of the weather enterprise and examines challenges and opportunities in the coming decade. It further explores three overarching components of the innovation cycle: infrastructure, research and development, and operation.
- **White Paper #2 on the Future of National Meteorological or Hydrometeorological Services**: Evolving roles and responsibilities: aims to inform key decisions on the future development of NMHSs, consider risks, opportunities and scenarios for the foreseen institutional, technological and operational changes, and enable better governance choices to mitigate possible negative impacts.

Two High-Level Sessions of the Open Consultative Platform (OCP) organized

- The Second Session (26–27 May 2021) was held as an online event during the COVID-19 pandemic. It brought together leaders from the NMHSs, private companies, meteorological equipment providers, the research community and academia. Two themes of common concern were discussed: **(1) the future of weather and climate forecasting and (2) the evolving roles and responsibilities of NMHS.**
- The Third Session took place on 20 June 2022 as part of the programme of EC-75. It urged actions in improving legislation, increasing data sharing, advancing the uptake of science and technology, adapting operating models, developing capacities and other key aspects which will **influence the evolving roles and responsibilities of NMHS**.

Consultations and innovation webinars/workshops

- **Eight OCP innovation webinars** held e.g., (1) with **Microsoft** on the SDGs and specifically on high-performance computing, visualization technology and cloud technology; (2) on Innovation and Cutting-edge Activities in **Space-borne Precipitation Measurements and Application**, and (3) on Improving decision making during **extreme flooding events**.
- A workshop on flood forecasting with **Google** held.
- Consultations conducted with **Hewlett Packard Enterprise**, **Everbridge**, **IOTA**, **Jupiter Intel**, **Weather Impact**, **tomorrow.io**, **Google**, **Microsoft** and Association of Hydro-Meteorological Industry (**HMEI**).
- Public-Private Engagement
- Exploratory PPE for **ocean services** commenced

Focus Area E

Services for Aviation

Globally, around eighty percent of Members implement **Quality Management Systems** (QMS) for aeronautical meteorological services, as presented on Figure 1.23. **Full QMS implementation is most predominant in Region VI. In Region III,** all Members implement QMS, even though a third do so only partially. **Regions II and V** the levels are in line with the global average, albeit Region II has the highest proportion of Members that do not implement QMS (9%) as compared to other regions. Region II and Region V comparatively lower percentages of QMS implementation are affected by the lower responses rate from their respective Members.

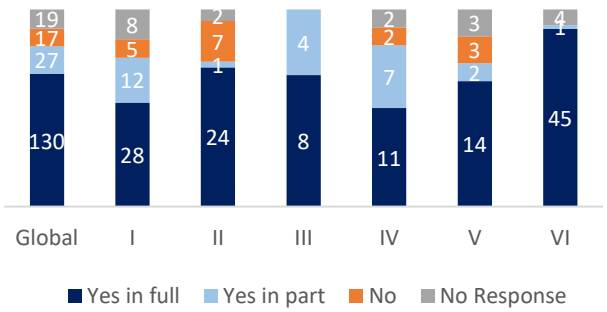


Figure 1.23 Number of Members with a QMS for the provision of aeronautical meteorological services. Global Survey on Aeronautical Met Service Provision, 2019

The following are highlights of key developments in the reporting period.

- Development and updates of regulatory, guidance and communications material:
  - **Volume I, General Meteorological Standards and Recommended Practices** (WMO-No. 49) and **Compendium of WMO Competency Frameworks WMO-No. 1209)** addressing the qualification and competency requirements of aeronautical meteorological personnel [for Cg-19 adoption]
  - **Volume II, Meteorological Service for International Air Navigation (WMO-No. 49)** to align with Amendments 79 and 80 of International Civil Aviation Organization (ICAO) Annex 3
  - Plan of action for the discontinuation of **WMO-No. 49, Volume II, Meteorological Service for International Air Navigation** [for Cg-19 approval]
  - **Guide to Services for Aviation** (WMO-No. 732), formerly titled Guide to Practices for Meteorological Offices Serving Aviation
  - **Aerodrome Reports and Forecasts**: A Users' Handbook to the Codes (WMO-No. 782), Guide to Aeronautical Meteorological Services Cost Recovery: Principles and Guidelines (WMO-No. 904)
  - **Compendium on Tropical Meteorology for Aviation Purposes** (WMO-No. 930)
  - **AeM SERIES No. 4**, Outcomes of the 2019 CAeM Global Survey Sensitivity Analysis of Future Meteorological Service Delivery to Aviation
  - **AeM SERIES No. 5**, Long-term Plan for Aeronautical Meteorology
  - **AeM SERIES No. 6**, Outcomes of the 2020 Survey on the Impacts of Climate Change and Variability on Aviation
  - **AeM SERIES No. 7**, Outcomes of the 2021 Global Survey on Gender Equality in Aeronautical Meteorology
  - **AeM SERIES No. 8**, Proceedings of the Eighth International Workshop on Volcanic Ash (IWVA-8)

- **2021 global survey on gender equality** in the aeronautical meteorology domain conducted (report due to be published in 2022 as **WMO AeM SERIES No. 7**)

Capacity Development:

- **Aviation Meteorology Training Seminars** conducted online in November 2021 and November 2022 in collaboration with the **UK** Met Office and the assistance of Meteorological Service **Singapore**, Bureau of Meteorology Australia and MetService **New Zealand**. More than 100 aeronautical meteorological personnel trained from WMO Regional Associations I, II, V and VI.
- **Aeronautical Meteorology Scientific Webinars** conducted online in June 2022 showcasing scientific and technological advances in support of aeronautical meteorology service provision. More than 250 participants from all six WMO Regional Associations. A further webinar series is being planned for December 2023.
- Information Sessions on a proposed amendment to **WMO's qualification and competency requirements for aeronautical meteorological personnel** conducted online in September 2022. More than 160 participants from all six WMO Regional Associations.
- Eighth International Workshop on **Volcanic Ash** conducted in February 2023 showcasing the latest meteorological, volcanological and geological advances and aviation industry needs. Nearly 60 participants from WMO Regional Associations II, III, IV, V and VI.
- Ongoing updates to the **Services for Aviation Moodle training portal** (online), which serves as a repository for a suite of course materials, guidance and other resources to support the education and training of aeronautical meteorological personnel and the implementation of a competency assessment framework.
- **Two issuances per annum of a Services for Aviation Newsletter**, providing more than 1,300 subscribers within the aeronautical meteorology community with news of developments taking place at the global and regional levels and showcasing local and national good practices in aeronautical meteorological service delivery.

Partnerships on aviation services

- Progression of an update to the **WMO-ICAO working arrangements**, establishment of regular coordination meetings (online and in-person) between the WMO and ICAO Secretariat, and planned introduction of a 'Joint Aviation Forum' between WMO and ICAO.
- Substantial active **WMO contribution to numerous ICAO groups** including the Meteorology Panel (METP) and the Airport Economics Panel-Air Navigation Services Economics Panel (AEP-ANSEP) addressing topics that include aeronautical meteorology service delivery improvement, aeronautical meteorological information exchange, volcanic ash and space weather services, institutional arrangements and governance, and aeronautical meteorological services cost recovery.
- Strengthened **WMO engagement** with aviation stakeholders, primarily through the **ICAO Committee on Aviation Environmental Protection (CAEP)**, on environment and climate issues (e.g. sustainable aviation and climate change adaptation, mitigation and resilience).

Forward perspective

In the coming years the transformation of aeronautical meteorological service provision, from traditional products to contemporary information services, will become more evident, linked to the broader modernization of the aviation industry. The roles and responsibilities of aeronautical meteorological services, including their personnel, will need to remain responsive to new or changing requirements, exploiting advances in science and technology and overcoming barriers to success. WMO will continue to play an important role in working with aviation stakeholders, particularly ICAO, in the development of requirements and supporting Members and their aeronautical meteorological service providers in the development of capabilities to fulfil the requirements. It is also anticipated that WMO will further its engagement with aviation stakeholders on the impacts of climate change on aviation, downscaled to the regional and local level where necessary.

The following guidance material is expected to be published by end-2023: Guide to Services for Aviation as a replacement of the Guide to Practices for Met Offices Serving Aviation (WMO-No. 732); Guide to Aeronautical Meteorological Services Cost Recovery, Principles and Guidance (WMO-No. 904). In addition, a 2023 update to the Long-term Plan for Aeronautical Meteorology (WMO AeM SERIES No. 5) is expected to be published.

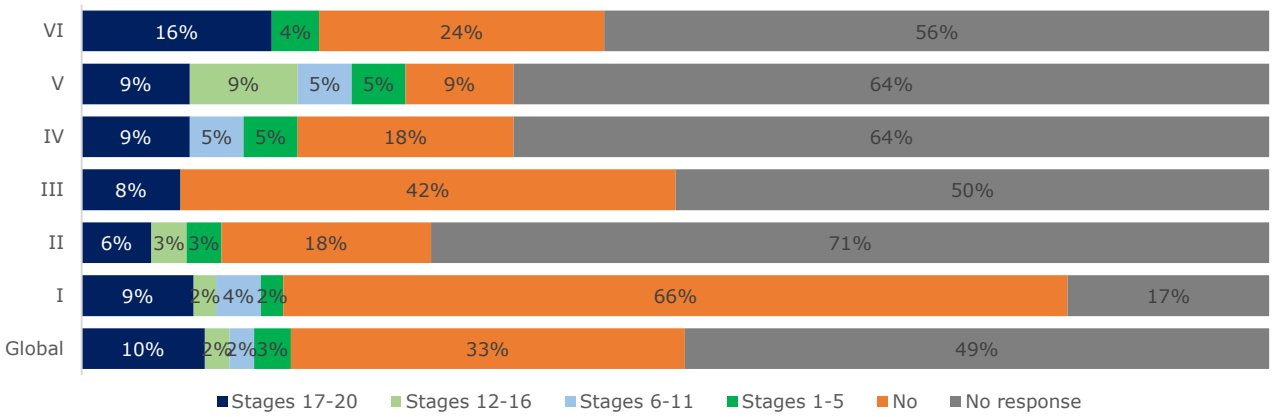


Figure 1.24 Proportion of Members with a QMS for the provision of marine meteorological services. WMO Monitoring, December 2021.

Marine Services

The **majority of Members with coastlines and lakes have not commenced implementation of QMS for marine services** (see Figure 1.24). 10% of Members have completed an external audit and have received certification (stages 17-20)[2]. A small portion (2%) have completed internal audits and management reviews (stages 12-16), whereas another 3% are at stages 1-5, i.e. gap analysis has not been completed yet.

The following are highlights of key developments in the reporting period.

Development and updates of regulatory, guidance and communications material:

- Updates to **Manual and Guide for Marine Meteorological Services (WMO-No 558 and 471)** approved in 2022, and a broader revision has commenced in 2023.
- **Sea Ice Information and Services (WMO-No.574):** revision published in 2021 (static version) and further revisions approved in 2022.
- Annual updates to **WMO No 9 Vol D. Information for Shipping**, continuing. (online version)
- Revision of **WMO. No 1076, Guide to Storm Surge Forecasting** – commenced in 2023
- **Interim Iridium SafetyCast service manual** – revisions submitted by WMO and IHO, approved by IMO (MSC.1/Circ.1613/Rev.1) in 2021, further minor revisions submitted by WMO and IHO to NCSR 10 in May 2023 for anticipated approval at MSC 107 in June 2023.
- **NAVTEX Manual** – revisions by WMO and IHO, submitted for approval by IMO, in early 2022, subsequently approved at MSC 106 in November 2022 and issued as MSC.1/Circ.1403/Rev.2 with an effective date of 1 January 2023
- **Marine Services Cost Options investigation** – the results are being presented to Congress-19.
- **JCOMM services** archive retrieval from the disbanded JCOMM website are now accessible from **WMO website**.
- Published **WMO MMO Series 3**, Report of the **First WMO-IMO International Symposium 'Extreme Maritime Weather: Towards Safety of Life at Sea and a Sustainable Blue Economy**
- **WMO-IMO Worldwide Met-Ocean Information and Warning Service portal** updated (hosted by Météo-France)
- Revisions of **Maritime Service descriptions** in the context of e-navigation for which WMO is domain coordinating body, namely **MS-13 (Ice navigation service)** and **MS-14 (Meteorological information service),** submitted to NCSR 10 in May 2023 for subsequent approval by MSC 108 in May 2024.Newly published **WMO. No 1293 Guidelines on Implementation of a Coastal Inundation Forecasting-Early Warning System**, and accompanying **explanatory video** outlining the 10 Steps for Implementation (Donors: KMA, CREWS).

[2] Implementation of QMS for marine services is assessed along the following stages of development: (a) Stages 1-5: gap analysis not completed; (b) stages 6-16: first internal audit completed (stages 6-11) management Review held, 2nd & 3rd internal audits, but no external audit (stages 12-16); (c) stages 17-20: external audit completed and certification received.

- Development of a **series of marine services information videos**, including for awareness of **coastal inundation** (what to do if it happens); the **value of ocean buoys; maritime safety services**; the role of **meteorological services in tsunami early warning**; and **marine emergency response**. Some of these have been regionalized and translated to local languages (e.g. For the Pacific and Caribbean SIDS – Donor: CREWS).
- Published **WMO MMO Series 4 Maritime Forecasting, Meteorology and WMO: History and Evolution** coinciding with the 150th Anniversary of WMO's origin.
- **Endorsement** of WMO 1293; MMO Series 4; and the marine service video series as activities of the **UN Decade of Ocean Science for Sustainable Development,** and in some cases, **EW4All**.
- Coordination and contributions to the **World Meteorological Day 2021** Ocean theme and publication of the **WMO Bulletin Special edition on ocean (Vol 70(1) – The Ocean, Our Climate, and Weather 2021**, and publication of the **WMO Ocean Video**, narrated by UN Special Envoy for the Ocean, Ambassador Peter Thomson.
- Contributions to discussions progressing ocean science for sustainable development at various fora including **the 2nd UN Ocean Conference (2022, Lisbon), and the UN Decade of Ocean Science for Sustainable Development** meetings.

Capacity Development and Competencies:

- **WMO Marine Weather Competencies**:
    - Approval of the ice competency framework at EC-76, for addition to the marine weather competencies in WMO-No.1209.
    - Development of draft marine weather competency toolkit for use by Members to implement marine weather competencies.
- **WMO Marine Services Course**
    - Phase I Online: Completed in RAIII and RAIV Spanish speaking Members, RAV English speaking Pacific Islands; RAIII and RAIV English speaking Caribbean Members; RAI Africa(English speaking). RAI (French speaking) is underway (March to May 2023). Preparations for RAI/RAII (Arabic speaking) to commence in October 2023.
    - Phase II (blended Face to Face): Completed RAV Pacific Island. Preparations are progressing for the completed Phase I regions.
    - The WMO Marine Services Course partially addresses marine weather competencies. Work to progress the implementation of Marine Weather Competencies has commenced in 2021 (see above).
- **Storm Surge training** for Fijian Meteorological Service (**Fiji**) forecasters, at the JMA (**Japan**) as part of the coastal inundation forecasting early warning system project (donor: KMA **Korea**)
- Development of an online resource for marine weather material
- Commenced review of marine weather aspect to the IMO model courses for mariners

Significant progress in strengthening maritime safety and other marine services have been demonstrated as follows:

Progress of actions from the **first WMO-IMO Symposium on Extreme Maritime Weather** are continuing, along with preparations for the **Second WMO-IMO Symposium**, which will be held in September 2024 at the IMO (London).

- Strengthened engagement in **marine polar activities** including with:
    - the Arctic Council's PAME Working Group, especially its Shipping Best Practice Forum. In particular, WMO has developed a polar entry point on the WMO website connected directly to the PAME Shipping Portal.
    - the IMO and Nautical Institute's Inaugural Polar Seminar
    - the International Ice Charting Working Group
    - coordination of the WMO Polar Side Event at the 2nd UN Ocean Conference (Lisbon, 2022)
    - Development of a polar marine services roadmap is underway
- **Revised Joint IMO/IHO/WMO Manual on Maritime Safety Information (MSI)** submitted to NCSR 10 in May 2023 for subsequent approval at MSC 107 in 2024.

- **Revised IMO International SafetyNET Services Manual** (MSC.1/Circ.1364/Rev.2) revised and operational
- **Interim International SafetyCast service manual** (MSC.1/Circ.1613/Rev.1) revised and operational
- **Marine Emergency Response (MER):** Establishment and maintenance of standards in meteorological services for marine emergency response, inclusive of both environmental emergencies, and Search And Rescue
    - Demonstration of the criteria for a RSMC MER is underway;
    - Drafting of Guidance material for the MER is underway, as requested by SERCOM Other marine related RMSCs:
- Approval of new RSMCs for **global numerical ocean prediction** (Canada, India), and **waves** (India)
- Strengthening marine service delivery in regional contexts, especially through:
    - Delivery of the WMO Marine Services Course (as above)
    - Coordination of **Ocean Side Events at RA Sessions** in RAIII, RAIV, RAV and RAII.
    - **Stocktake of ocean service delivery** in RAV (2022); and RAIV Caribbean (2023, donor CREWS Caribbean)
    - Targeted stakeholder engagement for developing marine service products in **Trinidad and Tobago** (2023, donor: CREWS Caribbean)
- Exploratory PPE for ocean services, has commenced, with Swiss based foundations.
- Partnerships on marine services
    - Strengthened engagement with key marine service partners and stakeholders, including IMO, International Hydrographic Organization (IHO), the Intergovernmental Oceanographic Commission of UNESCO (IOC), International Mobile Satellite Organization (IMSO), Arctic Council, and Nautical Institute and their subsidiary bodies where WMO is actively engaged.
    - Joint WMO-IOC Collaborative Strategy finalized and approved.

Forward perspective

The following regulatory and guidance material is expected to be updated and/or published in 2024: Manual (WMO-No 558) and Guide (WMO-No. 471) to Marine Meteorological Services; Guide to Storm Surge Forecasting (WMO-No1076), and a new Guide for Marine Emergency Response. Expanding the knowledge of user requirements, to inform the further development of new and innovative ocean prediction products and services will be a focus. The need for strengthened delivery of coastal early warnings in vulnerable low lying coastal countries, especially SIDS, is an emerging priority. Related to this, **an Adaptation Fund pre-proposa**l has been accepted and work is underway on a full proposal for scaling up the Coastal Inundation Forecasting Initiative (CIFI) for **Fiji**.

The strengthened capacity of NMHS to deliver marine services is a target focus, for which the **WMO Marine Services Course** will continue being rolled out across regions through to 2025/2026. This will partially address marine weather competencies, which further complementing the implementation of marine weather competencies, which will be strongly encouraged globally. Tied in with updates to the marine weather training for mariners, as part of the IMO model courses, the intent is to 'close the gap' in understanding, communication and engagement between the metocean forecasters and the mariners using the marine products and services, for safety of life at sea, and along the coast.

Strengthening marine service delivery in regional contexts, and including connection to users of marine products, and development of **impact-based forecasting marine, and coastal MHEWS products** is a targeted focus in the future. This also relates to strengthened capacity development and implementation of **marine weather competencies**, at global and regional levels. Regarding innovations **in ocean forecasting and prediction services**, marine services will increasingly consider **strengthening of marine related RSMCs** including development of RSMC for global storm surge prediction. For maritime safety standards, there will also be a focus to strengthen development of **WMO led S-100 based product specifications** – S-411 to S-414 – to align with the IMO endorsed IHO S-100 development roadmap and operational timeframe.

Forward perspective

The **2nd WMO-IMO Symposium in 2024** will be an opportunity to continue closing the gap between the metocean community, and users of marine weather products. While global in scope, it is anticipated that the Symposium will launch the start of regionally focused discussions for improving **safety of life at sea**.

Public Weather & Early Warning Services

As evident from Figure 1.25, significantly fewer Members implement QMS for early warning services. **Almost half of Members in Region VI, 38% of Region I and 36% of Region II implement such a system fully or partially**. The trend is reversed in Region III where QMS implementation for early warning services is not a common practice. The data available on Regions IV and V is not representative and hence no meaningful analysis could be conducted.

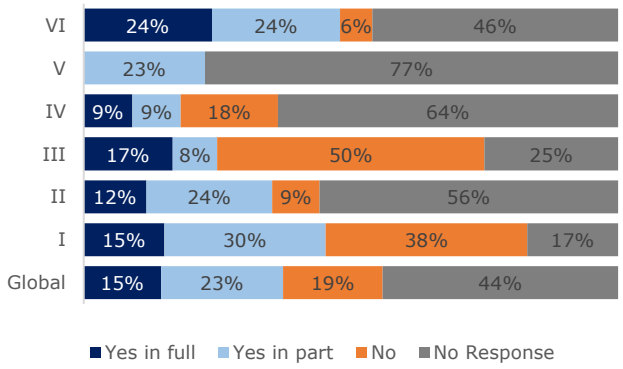


Figure 1.25 Proportion of Members with a QMS for the provision of early-warning services. WMO Monitoring, December 2021.

Service Delivery

Figure 1.26 presents the responses of the 71 Members who provided data on the communication channels used to disseminate products and services to the public (response rate of 37%). Though incomplete, the responses show that **web applications** are NMHSs' preferred communication channel across most Regions, only being marginally surpassed by **radio** in Region I. **Mobile applications** place second in Regions II and V, while they are least used in Region I. Data from Region III is too sparse to allow for meaningful conclusions to be drafted.

Updates to WMO Strategy for Service Delivery and its implementation plan

Submitted to Cg-19 for adoption, the proposed 2023 update (third edition) of **WMO-No. 1129** provides a strategy to WMO Members and their NMHSs in the provision and continuous improvement of value services, identification of key stakeholders and partnerships, trends, socio-economic benefits, and a **Strategic Roadmap** for the improvement of services at the national level highlighting the WMO support systems. It further complements other WMO guides and guidelines on service delivery.

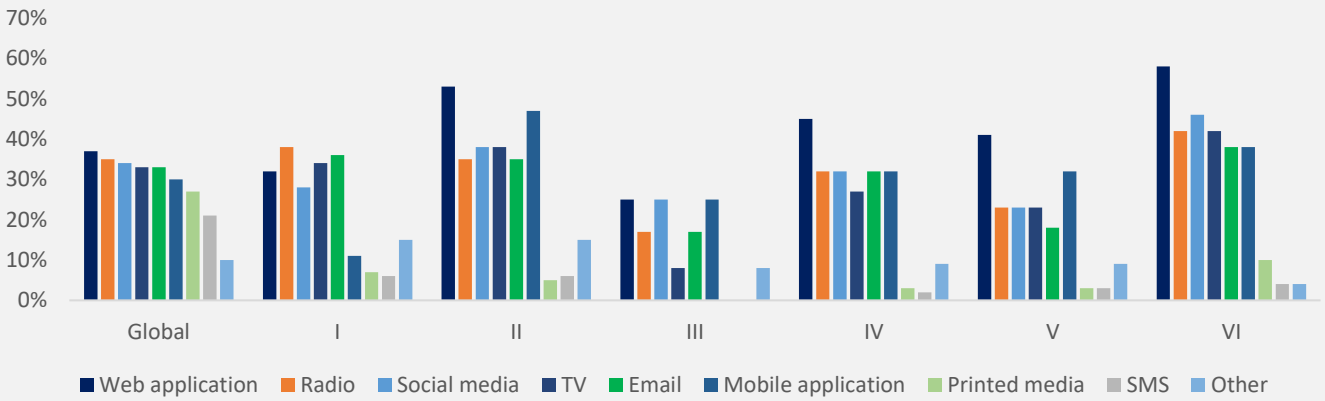


Figure 1.26 Proportion of Members using web applications, social media and/or other communication channels in service delivery, WMO Monitoring, December 2021.

Forward perspective

According to ITU estimations at the end of 2022, mobile broadband networks are accessible to 96% of the world population, active subscriptions reaching more than 6 billion. **Mobile communication channel** usage is therefore certainly going to further increase in the future, although significant efforts may be needed in a number of countries. **For warning dissemination, using as many options as possible** is needed more than ever to ensure all people and users at risk receive warnings and take action accordingly.

Whereas some progress on service delivery to polar and high mountain regions is expected by end-2023, continued effort will be required, especially on high mountain areas for developing Members.

Project Highlights

Integrative Health Services | Global | 210,000 USD | 2019-2023

A joint World Health Organization (WHO)/WMO online portal (climahealth.info) was designed, developed, and launched in November 2022. ClimaHealth's goal is to facilitate access to actionable knowledge in order to protect populations from the health risks of climate change and other environmental hazards. This authoritative global open-access platform was developed to serve as a technical reference point for users of interdisciplinary health, environmental, and climate science. It features profiles of the climate and health products and services provided by NMHS, a research literature portal, country, hazard, and thematic technical pages, a progress data dashboard, and other resources. The site represents the public face of the WHO-WMO Joint Technical Programme, bringing together the expertise and science of both organizations for the first time.

CREWS | Togo | RA I | CHF 1 Mio | 2019–2024

Under this project, ANAMET launched their new website that will allow the community and the different sectors to access weather, water and climate information.

CREWS | Democratic Republic of Congo | RAI – (WMO component) | CHF 300,000 | 2017-2023

A socio-economic benefit analysis was conducted during early 2023 with the objective of studying the effectiveness of the investments made by the World Bank and CREWS Initiative (total USD 13 M) in the last 5 years. The study demonstrated the importance of governmental investments to make progress sustainable. Benefits from the investments are estimated in millions of dollars considering the improvement of services, especially for the aviation sector. Also, it is estimated that households realize social benefits from accessing and understanding weather information. While higher-income households would be more likely to have access to weather information if the services were available, the greatest benefits from access to climate information would be for lower-income households involved in agricultural activities.